SCIENCE ABSTRACTS.

Section A.—PHYSICS.

OCTOBER 1905.

GENERAL PHYSICS.

1839. *Rubber-tube Rotating Pump without Valve.* **K. Prytz.** (Zeitschr. Instrumentenk. 25. pp. 193–198, July, 1905.)—A rubber tube is wound on a cylinder, and a roller which compresses the tube causes suction or compression by rolling round the cylinder, a valve being dispensed with by coiling the tube a little more than once round. The ends of the tube pass to the interior of the cylinder and so to the outside. When used as a suction pump, a pressure of about 30 mm. of Hg can be reached; the compressing power of the pump depends on the strength of the rubber, tubing of 3 mm. bore and 3·5 mm. thickness of wall being found a convenient size. The use of the machine for slow pumping is illustrated by means of such processes as isolation of argon from atmospheric gases, investigation of radio-activity of spring water, and the raising and lowering of mercury in long vertical tubes.

G. E. A.

1840. *Electrically-operated Gyroscope.* **E. Durant.** (Scientific American, 93. p. 50, July 15, 1905.)—A stationary ring is mounted on a stand and carries the conducting wires which convey the current to mercury cups located at the gimbal pivots of the two movable rings, and thence to the magnetic field ring and the armature brushes. One movable ring is pivoted to rotate in a vertical plane. The magnetic wire-wound field ring is gimballed to rotate in a horizontal plane, while the armature is pivoted vertically in the field ring, and is in line with the vertical axis of the outer movable ring. A special weight attachment to the armature axis near one end is caused to move to and from the armature disc by a worm and wheel arrangement; and by means of this the apparatus can be made to show orbital motion. The gyroscope has a constant angular velocity and a constant orbital time. A relatively light weight, oscillated radially by means of worm gear, is used with the instrument to exhibit nutation. An illustration is given. A. W.

1841. *Lanchester's Pendulum Accelerometer.* **F. W. Lanchester.** (Phil. Mag. 10. pp. 260–268, Aug., 1905. Communicated by the Physical Society.)—In this instrument the pendulum-lever is extended upward beyond its axis of oscillation, and an arm is pivotally mounted on this extension so as to turn about an axis perpendicular to the axis of oscillation of the pendulum. The free end of this arm bears the recording pencil or stylus, which rests on and moves across a band of paper fed along at a uniform rate by clockwork in a direction perpendicular to the direction of motion of the pencil. Since the acceleration $= g \tan a$, where a is the angle of deflection of the pendulum, it will be seen that a uniform acceleration scale will be obtained by this arrangement. Another feature consists in the shortness of the pendulum, viz., $1\frac{1}{4}$ in., so that its time of oscillation shall be small. A dash-pot consisting of a ball working loosely in a cylinder of viscous oil is pivotally attached to a laterally-extending arm on the pendulum, making the instrument as near as possible dead-beat. C. K. F.

1842. *Densities of Carbon Dioxide, Ammonia, and Nitrous Oxide.* **P. A. Guye** and **A. Pintza.** (Comptes Rendus, 141. pp. 51–53, July 3, 1905.)—The authors give results of measurements, by the method previously described [see Abstract No. 224 (1905)], of the densities of carbon dioxide, ammonia, and nitrous oxide. The following are the weights in gm. obtained for 1 litre of the gas at 0° and 760 mm. pressure, together with the values found by Leduc and Rayleigh :—

	Guye and Pintza.	Leduc.	Rayleigh.
Carbon dioxide	1·9768	1·9763	1·9769
Ammonia	0·7708	0·7719	—
Nitrous oxide	1·9774	1·9780	1·9777

The following values are calculated for the atomic weight of nitrogen : From the relation $N_2O : CO_2$, 14·007 ; from $N_2O : CO$, 14·006 ; from $N_2 : O_2$, 14·009. T. H. P.

1843. *Inconstancy of the Specific Gravity.* **G. W. A. Kahlbaum** and **E. Sturm.** (Zeitschr. Anorg. Chem. 46. 3. pp. 217–310, Sept. 2, 1905. Dissertation of E. Sturm. Phys. Chem. Laborat. d. Univ., Basel, May 31, 1905.)—The paper first gives a very full account of the observations which have hitherto been made on the variation of the specific gravity of metals, and especially that produced as a result of mechanical deformation (due to wire-drawing) and previously described by Kahlbaum [see Abstract No. 2104 (1904)]. A much fuller account of the weighing arrangements, with a discussion of the errors, is given, and experiments are described which extend the investigation so as to include the effects of torsion and the alteration in electrical conductivity, which latter was previously only touched upon. In addition to commercial Pt, the metals pure Pt, Pt-Ir, Au, Al, Cd, Ni, Fe, Ag, Cu, Sn, and Al-bronze, as drawn wires, and several easily fusible alloys as pressed wires, were examined. Fe, Ag, and Cu gave no satisfactory results (occlusion, &c., troubles), but the previous results are confirmed as regards the increase of sp. gr. resulting (also in Cd) from annealing the hard wire, Ni showing by far the largest increase. The effect of torsion applied to the annealed wire is similar to that produced by drawing, *i.e.*, to make it hard and lighter ; to be restored to the soft state and greater sp. gr. by re-annealing. The greatest differences in the behaviour under the two different deformations are shown by pure Pt (twisted wire, 21·3985 ; annealed, 21·4312 ; diff., + 0·0327. Drawn wire, 21·4336 ; annealed, 21·4403 ; diff., + 0·0067) and by Ni (twisted, 8·8273 ; annealed, 8·8412 ; diff., +0·0139. Drawn, 8·7599 ; annealed, 8·8440 ; diff., + 0·0841). The resistivity was determined by Benoist's method (Construction des étalons de résist. électr., Paris, 1885, p. 53). In all cases, without exception

(Fe not tried), an increase of conductivity is observed in changing from the hard to the soft state, this change varying from 0·26, 0·61, and 0·63 per cent. for Au, Pt, and Cu respectively, to 15·04 per cent. for the Al-bronze. The e.m.f. between twisted and annealed wires of Cu, Ni, Sn, Pt, and Au in 1 per cent. sulphuric acid was also measured, Spring's results being confirmed [see Abstract No. 1242 (1904)]. Only in Pt and Au was the direction of the current from soft to hard; in the other metals the reverse. The molecular state of the material is then discussed. A shorter account is also given in Phys. Zeitschr. 6. pp. 516–520, Aug. 15, 1905. L. H. W.

1844. *Transmission of Impulse along a Water-tube.* **G. Giorgi.** (Atti dell' Assoc. Elettr. Ital. 9. pp. 249–256, May–June, 1905.)—The problem solved by L. Allievi [see Abstract No. 1245 (1904)] is here treated more generally; the tube is not supposed to be uniform, the diam. and thickness of wall both varying. The equations of Allievi become—

$$\partial\phi/\partial x + \lambda\partial v/\partial t = 0$$
$$\lambda\partial(Sv)/\partial x + K\partial\phi/\partial t = 0,$$

where ϕ = pressure, v = velocity of fluid, λ = density of fluid, S = section of tube and K = coefficient of compressibility due to the resultant elasticity of both fluid and tube. From these, expressions for the velocity in terms of x and t are obtained in two terms, one of which is definite and a propagation term, and the other a dissipative term which is inexpressible in ordinary functions. Further, in a non-uniform conductor, an impulse is propagated with velocity $\sqrt{S/K}$ which is variable along the length of the tube, but whose value at any point is the same as though the tube were uniform, and at the same time the impulse becomes attenuated but in no case entirely dissipated. The case in which viscosity is taken into account is also considered, and it is shown that this does not affect the velocity, but superimposes an attenuation term upon that due to the non-uniformity of the tube. [See also Abstracts Nos. 1682 and 1684 (1905).] S. G. S.

1845. *Stresses in Dams.* **J. S. Wilson** and **W. Gore.** (Engineering, 80. pp. 134–135, Aug. 4, 1905.)—The stresses in the dam are investigated by means of a slab of indiarubber loaded to give a fictitious density of 2·25; the shape of the slab is the cross-section of the dam, and the water pressure and the resistance at the base are applied by cords passing over pulleys and carrying weights. The slab is photographed in the loaded and unloaded conditions, and the strains directly measured. S. G. S.

1846. *Failure of an Iron Plate through "Fatigue."* **S. A. Houghton.** (Iron and Steel Inst., Journ. 67. pp. 383–389; Correspondence, pp. 390–394, 1905. Mech. Eng. 15. pp. 707–708, May 20, 1905.)—Describes the failure of a barrel plate of a boiler, the plate having been exposed to severe "panting" stresses. A photomicrograph of the metal is shown. The author's conclusion is that cracks formed, commencing as a rule from irregularities on the inner surface, due to weakness in the cleavage planes of the crystals from continual slipping, and to a less degree to loss of adhesion between the crystals. Some of the crystals appear to have been broken up; the slag flaws seem to have a restraining effect on the progress of the cracks. W. Ros.

1847. *Brittleness of Steel, and Effects of Shearing, Punching, &c.* **C. Frémont.** (Comptes Rendus, 141. pp. 325–327, July 31, 1905.)—The following table shows the numbers of kg.-m. absorbed in the author's shock test upon A and B brittle, and C tough, boiler-plates, such as ordinarily occur. Specimens were cut with the tension side tangential to the hole, made as stated.

	Not Notched.			Notched.		
	A	B	C	A	B	C
Original metal..............	20	26	50	2	6	28
Drilled	18	26	—	2	8	—
Punched and drilled	20	22	—	4	4	—
Punched	6	8	42·7	3	3	26·7
Punched and reamed ...	—	—	23·5	—	—	18

Throughout, the tough metal remains relatively tougher than the brittle specimens; and it is concluded that brittleness of steel is a graver fault than departure from best approved boiler-making practice. F. R.

1848. *Coefficient of Viscosity of Gases.* **S. Chella.** (Accad. Lincei, Atti, 14. pp. 23–30, July 2, 1905.)—Instead of a vibrating disc, a hollow cylinder vibrating between an inner and an outer fixed cylinder is employed. The damping is observed, and the vibrating cylinder is then replaced by another of the same moment of inertia and cross-section but of different length, and the damping again observed. The first part of the paper is a calculation of the coefficient of viscosity of the gas occupying the space between the cylinders in terms of the damping and the constants of the apparatus; the second part is a description of the apparatus. No results are given.

S. G. S.

1849. *Analogy between Lesage's Gravitation Theory and the Repulsion of Light.* **G. H. Darwin.** (Roy. Soc., Proc. Ser. A. 76. pp. 387–410, Aug. 4, 1905.)—An analysis of the Lesage corpuscular mechanism is given for the case in which two particles of gross matter are near one another. The analogies to repulsion by radiation are then indicated. The consequences of perfect and imperfect elasticity, perfect and imperfect roughness are considered. The work shows that Kelvin's hypothesis of the repartition of the vibrational and translational energies will not meet the defects of Lesage's hypothesis.

J. W. P.

1850. *Stresses in the Earth's Crust.* **C. Chree.** (Phys. Soc., Proc. 19. pp. 568–587, July, 1905. Phil. Mag. 9. pp. 785–802, June, 1905.)—In order to estimate the effect of sinking a deep bore-hole in the earth, calculations are made, on the elastic solid theory, of the stresses within and upon solids of different shapes and under different circumstances. Applied to the earth, these seem to indicate that, while the internal stresses due to rotation must be considerable, they are in large measure neutralised by the compensating action of the spheroidal form on the gravitational stresses, so that the combined effect of rotation and ellipticity will not affect a 12-mile bore-hole any more than an ordinary mine; that the earth must be approximately considered as having an incompressible nucleus and a compressible crust; that the bottom of a bore-hole seems not so weak a spot as the walls of the boring a few diameters of the bore above the bottom; and that the largest value of the maximum stress-difference anywhere over the surface of the bore-hole is twice the hydrostatic pressure that would exist at its bottom if it were filled with a liquid whose density equals the mean density of the core extracted.

R. E. B.

REFERENCES.

1851. *Shortened Self-acting Mercury Pump.* **E. Regener.** (Deutsch. Phys. Gesell., Verh. 7. 13. pp. 233–235, July 15, 1905.)

1852. *New Form of Pyknometer.* **R. V. Stanford.** (Phil. Mag. 10. pp. 269–270, Aug., 1905. Communicated by the Physical Society.)

1853. *Interchangeability of Large Screws.* (Engineering, 80. pp. 141–144, and 146 and 147, Aug. 4, 1905. Engineer, 100. p. 172, Aug. 18; 198, Aug. 25; 249–250, Sept. 8, and pp. 271–272, Sept. 15, 1905.)—Deals with the recommendations of the committee appointed to consider the question of master leading-screws. The allowable errors are stated, and the standard screw-adjusting machine in the National Physical Laboratory illustrated. In an appendix by R. T. Glazebrook, the calibration of the scales of the machine is dealt with.

1854. *Harmonic Analysis of Valve Motions.* **S. P. Thompson.** (Engineering, 80. p. 36, July 14, 1905.)—The method of harmonic analysis previously described by the author [see Abstract No. 1331 (1905)] was applicable to functions containing odd harmonics only. Valve motions, however, contain even harmonics as well. A modification of the original method is described which is applicable in the more general case of valve motions, and this is illustrated by the harmonic analysis of a Stephenson's valve-gear motion. A. H.

1855. *Current Theories of the Consolidation of the Earth.* **T. J. J. See.** (Nature, 72. pp. 30–31, May 11, 1905.)—The views of Kelvin, and Darwin, that the consolidation of the earth was brought about by the building up of a solid nucleus through the sinking of portions of the crust of greater specific gravity are questioned.

C. P. B.

1856. *Observations of Stars in British Stone Circles.* **N. Lockyer.** (Roy. Soc., Proc. Ser. A. 76. pp. 177–180, May 24, 1905.)—The inquiry was undertaken to ascertain if there were any traces in Britain of the star observations connected with the worship of the sun, similar to those formerly indicated by researches on the Egyptian temples, the same idea being followed, viz., the successive small changes of the axis necessitated by the change in a star's place due to precession. Two British monuments show this peculiarity in a convincing manner, the three circles known as the "Hurlers," near Liskeard, Cornwall, and the remains at Stanton Drew, in Somerset. It is found that in both cases the star under observation was Arcturus.

C. P. B.

1857. *Nebular Hypothesis.* **J. Halm.** (Roy. Soc. Edinburgh, Proc. 25. pp. 553–561, 1904–1905.)—A discussion of the probable necessary modifications of Laplace's theory to include modern investigation. C. P. B.

LIGHT.

1858. *Optical Glasses.* **W. Rosenhain.** (Engineering, 79. pp. 764–765; Discussion, p. 765, June 16, 1905. Paper read before the Optical Convention.) —The properties of glasses as substances which, in cooling from the molten state, might either crystallise or vitrify, are considered. In some glasses, distinguished by extreme constants, the tendency to crystallisation was great. As the range of glasses probably cannot be much extended on the lines of manufacture hitherto pursued, we must, instead of preventing crystallisation, aim at producing suitable crystals. New transparent materials would have to be brought into requisition, and the crystallising process governed by a very careful regulation of temperature during cooling. In the *discussion*, **H. Beck** testified to the astonishing results already achieved by the author. **S. P. Thompson** would not exclude doubly refracting crystals; would be delighted to have artificial calc-spar; and if we could make diamonds of reasonable size, all the better for optics. The **Author,** in reply, following up a remark by **S. D. Chalmers,** said he had prepared two new glasses which gave perfect achromatism. G. E. A.

1859. *Method of Studying Luminous Phenomena which vary in Intensity with the Time.* **A. Turpain.** (Comptes Rendus, 141. pp. 422–424, Aug. 28, 1905.) —The rays from an intermittent source and from its image in a plane mirror some distance behind it are reflected at 45° from a rotating mirror and focussed on a photographic plate, two series of direct and reflected images being obtained. The relative displacement, l, of the direct and reflected images, and the distance, l', from the first maximum of one image to the second maximum of the same series, are both measured by microscope. These two quantities are also expressed by simple relations, including the angular velocity, ω, of the mirror, and the period, T, of the intermittent source, viz., $l = 4\omega Dd/V$, and $l' = \pi NTd$, where D is distance of fixed mirror behind source, d the distance of the sensitive plate from the rotating mirror, V the velocity of light, and $\omega = 2\pi N$. The method may therefore be employed to measure N or T, and it has been applied in studying the sparks of a Hertzian exciter and resonator. G. E. A.

1860. *Photochemical Brightness of the Electric Arc.* **J. Precht** and **E. Stenger.** (Zeitschr. Wiss. Phot. 3. pp. 36–39, 1905.)—Determining the photochemical effectiveness of the electric arc by means of exposures in the blue, green and orange regions with the aid of a three-colour camera, the authors find that with increasing energy consumption in the arc, the quantity of blue rays increases more rapidly than that of the green and red rays.

L. H. W.

1861. *Radiation Constant Simply Determined.* **A. D. Denning.** (Phil. Mag. 10. pp. 270–278, Aug., 1905. Communicated by the Physical Society.)— This simple laboratory method of determining the radiation constant is due to a suggestion by J. H. Poynting. The principle of the method may be thus briefly described: A radiator with a blackened hemispherical concavity is quickly placed over a silver disc which forms one junction of a constantan-silver thermoelectric couple. From observations, at definite intervals of time, of the deflections of a low resistance moving-coil galvanometer in the circuit, the initial rise of temperature of the disc is obtained. This, together with the temperatures and constants of the apparatus, affords the required data. Thus if T and T_1 are the absolute temperatures of disc and radiator respectively, A the area of the disc, and σ the radiation constant, we have by Stefan's law: Rate of disc's gain of heat $= A\sigma(T_1^4 - T^4)$...(1). But this also $= ms\,dT/dt$...(2), where m and s denote the mass and specific heat of the disc. Thus we have—

$$\sigma = [ms/A(T_1^4 - T^4)]\ dT/dt \quad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Ignoring two low values, the average of the remaining nineteen results gave for silver—

$$\sigma = 5{\cdot}3 \times 10^{-5} \quad \ldots\ldots\ldots\ldots\ldots\ldots(4),$$

the mean of Kurlbaum's more elaborate experiments being $5{\cdot}32 \times 10^{-5}$.

E. H. B.

1862. *Celestial Spectroscopy.* **L. Puccianti.** (N. Cimento, 9. pp. 393–475, June, 1905.)—The paper consists of an extensive discussion of Kirchhoff's law and its applicability to spectroscopy. So long as radiation is due to temperature the law is applicable, but the evidence that this is the case is not complete. Owing to the difficulty of maintaining a gas at constant high temperature and at the same time insuring that no chemical action is going on and that no electrical cause is acting, it is impossible to say that radiation is a purely thermic phenomenon. The experiments of Pringsheim, Paschen, Smithells, Liveing and Dewar, Mrs. Ayrton, Rapp, and Hemsalech are cited, and the case of flames, electric arc, discharge at low gas pressure, and the electric spark are dealt with. The phenomenon of inversion of the spectrum is considered to be due to resonance, and the experiments lead to the conclusion that there are many orders of excitation and that the highest order which can be produced in the laboratory is of the lowest order of that taking part in celestial phenomena; temperature is only one of the causes of excitation. The effect of anomalous dispersion is then discussed, and an experiment is described in which the absorption lines of sodium are measured with varying density of sodium vapour in the flame producing absorption. As the band is broadened it is at the same time displaced. By a previously described interference method [see Abstract No. 455 (1902)] a number of lines due to Fe, Ca, Sn, Ba, and Mg are measured along with their displacements due to anomalous dispersion.

S. G. S.

1863. *Spectra of Weak Luminescences.* II. *Thermo-Luminescence Spectrum of Fluor-spar.* **H. W. Morse.** (Astrophys. Journ. 21. pp. 410–417, June, 1905.)—In a previous paper the author has described the fluorescent spectrum of certain fluorites, showing that it is composed to a great extent of bright lines [see Abstract No. 1209 (1905)]. In the present paper the thermo-luminescent spectra of two specimens of fluorite are described. In one case, a chlorophane, the spectrum consists of a nearly continuous band with a maximum in the green-yellow, with a series of sharp lines superimposed. In the second case, several broad and diffuse bands were shown with a series of sharp lines. The spectra were photographed, and the wave-lengths of the lines are given in the paper; some of the lines are common to the two spectra, but, with the possible exception of a line in each case at $\lambda = 5893$, none have been traced to any metal.

E. C. C. B.

1864. *Relative Positions of the Arc and Spark Lines of Titanium, Zinc, and Iron.* **N. A. Kent.** (Amer. Acad., Proc. 41. No. 10. pp. 281–300, July, 1905.)—In this paper the author extends his investigation of the possible relative shift of the arc and spark lines of titanium [see Abstract No. 1404 (1904)]. In the previous paper it was shown that the wave-lengths of certain lines of the titanium spark spectrum are sensitive to certain conditions in the electric circuit. In the present paper is described a continuation of the experiments with greater dispersion and more powerful electrical apparatus, full details of which are given. There appears to be no doubt that under certain conditions, viz., absence of self-induction, presence of large capacity, and the use of terminals of high-percentage alloy, the wave-lengths of certain lines on the spectrum of the spark close up to the terminals are slightly larger than those of the same lines in the arc spectrum. The author attributes this to the increased pressure in the metallic vapour close up to the terminals. E. C. C. B.

1865. *Infra-red Spectrum of CO_2 and Nitrogen.* **E. R. Drew.** (Phys. Rev. 21. pp. 122–128, Aug., 1905.)—In a previous paper the author noticed a band at $\lambda = 4{\cdot}75\ \mu$ in the radiation from the positive column of the electric discharge through air under reduced pressure [see Abstract No. 280 (1904)]. In the present investigation the author traces the origin of this band in nitrogen and not carbon dioxide. The wave-length of the band is sufficiently near to the well-known band of CO_2 at $\lambda = 4{\cdot}4\ \mu$ to justify experiments being undertaken to find whether or no the band belongs to this gas. It is well known that the position of the CO_2 band varies with the temperature from $\lambda = 4{\cdot}27\ \mu$ at 17° to $4{\cdot}4\ \mu$ at the temperature of the Bunsen flame. It was found, however, that nitrogen carefully freed from oxygen and carbon dioxide gives the band at $\lambda = 4{\cdot}75\ \mu$, and, moreover, that there is no displacement with change of temperature produced by change of pressure. E. C. C. B.

1866. *Fluorescence.* **C. Camichel.** (Comptes Rendus, 141. pp. 185–188, July 17, and pp. 249–252, July 24, 1905.)—The author has already described experiments which show that the coefficient of absorption of uranium glass does not change when fluorescence occurs; in answer to a suggestion of Burke's [see Abstract No. 1573 (1905)], he now confirms his former work by experiments in which the source of light is the fluorescent body itself. It is found, in addition, that the intensity of the light emitted by a fluorescing body is proportional to the intensity of the emerging light. D. H. J.

1867. *Phosphorescence of Zinc Sulphide caused by Condensed Gases from Rare-earth Minerals.* **C. Baskerville** and **L. B. Lockhart.** (Amer. Journ. Sci. 20. pp. 93–94, Aug., 1905.)—Powdered minerals were heated in a closed tube of hard glass and the liberated gases condensed on screens of Sidot's blende; the glowing of the screen was assumed to indicate the condensation of the emanation. The brightest glow was obtained from carnotite from Colorado, fergusonite from Sweden, samarskite and uraninite from North Carolina. Although the experiments were only qualitative, it appeared that those minerals which are the richest sources of helium gave the greatest amount of emanation. T. M. L.

1868. *Regeneration of Barium Platinocyanide Screens.* **Bordier.** (Archives d'Él. Médicale, 13. pp. 611–617, Aug. 25, 1905. Congrès Internat. de Physiothérapie, Liége, 1905.)—Platinocyanide which has become useless from long use or exposure can have its activity restored by breaking up the screen, dissolving the platinocyanide in hot water and recrystallising, or the whole screen, without being broken up, can be treated if the outer collodion film be first removed and replaced by a glass plate which will allow access of moist air to the salt. In the case of the platinocyanide being mixed with a substance which does not prevent the ingress of moisture, the mere placing of a sheet of moistened paper against the platinocyanide layer will serve the same purpose. [See Abstract No. 1216 (1905).] L. H. W.

1869. *Light-emission caused by Ionisation of Gases.* **R. Pohl.** (Ann. d. Physik, 17. 2. pp. 375–377, July 4, 1905. Phys. Inst. d. Univ., Berlin, May, 1905.)—B. Walter's experiments [see Abstract No. 1741 (1905)] are first confirmed. It is found that when nitrogen is ionised by radio-tellurium an emission of light takes place which is capable of acting on a photographic plate. This light is located in the visible as well as the ultra-violet part of the spectrum. A similar effect, as far as the ultra-violet is concerned, is produced by Röntgen rays. That light waves, or something closely resembling them, should be produced by ionisation has been predicted by J. Stark and J. J. Thomson. [See also Abstract No. 1597 (1905).] R. S. W.

1870. *Absorption of Röntgen Rays.* **B. Walter.** (Ann. d. Physik, 17. 3. pp. 561–571, July 18, 1905. Phys. Staatslaboratorium, Hamburg, March, 1905. From "Fortschr. auf dem Gebiete der Röntgenstrahlen," 8. p. 297, 1904–1905.)—Röntgen's simple absorption law, according to which the absorption of Röntgen rays is simply proportional to the thickness and density of the material traversed, does not suffice to explain the anomalous position of silver and its allies, in which any radiation which has already passed through acquires a very high penetrating power for metals of the same kind. The author attempts to explain this anomaly by considering the secondary radiation, but is obliged to renounce the latter on finding that the distance between successive screens is immaterial. He is finally led to the conclusion that the atom itself modifies the rays it transmits, in such a manner as to render them more penetrating for any subsequent material. To this action a special effect is added in the case of Ag, Pd, Cd, Sn, and Sb, rendering the rays more penetrating for these particular metals. If the central portion of a Benoist scale is constructed of one of these metals, and a plate of the same metal is introduced in the path of the rays, the central portion appears relatively brighter than before. It is already known that secondary rays penetrate those substances most easily in which they have been generated.

E. E. F.

1871. *Induced Thorium Activity.* **F. v. Lerch.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 553–583, May, 1905. From the II. physik. Inst. der k.k. Univ., Wien.)—Experiments have been made to discover whether ThX is precipitated on to metals from acid solutions. A solution of the salt in HCl makes the following metals active when they are placed in it, viz., Mg, Fe, Zn (amalgamated or otherwise), Ni, Pb, Cu, Al. This is not, however, due to ThX, but is induced activity. Pd and Pt show scarcely any activity. If these metals, as well as Pt, are made the anode in an electrolytic cell, induced activity is found thereon, but again no ThX. If the small amount of the anode that goes into solution be precipitated by suitable means, ThX comes down with it. On the other hand, alkaline solutions deposit ThX on metals placed in them. R. S. W.

1872. *Thorianite, a New Radio-active Mineral.* **W. R. Dunstan** and **G. S. Blake.** (Roy Soc., Proc. Ser. A. 76. pp. 253–265, July 10, 1905. Chem. News, 92. pp. 13–15, July 14; and pp. 26–28, July 21, 1905.)—Thorianite, from Ceylon, contains about 75 per cent. ThO_2 and smaller amounts of UrO_2 and oxides of the rare-earth metals. When heated it liberates 10·5 cub. cm. of gas, chiefly helium, from each gm. of mineral. The mineral is probably an isomorphous mixture of ThO_2 and UrO_2, and except for the great predominance of thoria is very similar to uraninite (pitchblende), which has an identical crystalline form. The radio-activity of the mineral is similar to, but rather less than, that of pitchblende, and the rate of decay of the activity of the emanation from the mineral suggests the presence of radium. T. M. L.

1873. *Spanish Radio-active Minerals.* **J. Munoz del Castillo.** (Real Acad. de Ciencias, Madrid, 1. 6. pp. 423–427, Oct., 1904.)—The author has examined some uraniferous minerals from Colmenar Viejo, and Torrelodones, and compared their activity with that of samarskite from the United States, of Moissan's uranite, and also of thorium oxide. By the electroscopic method the activity, as defined by the ratio of the time taken for the Al leaf to fall ten divisions by leakage alone to that when the mineral is placed on the lower plate, was found to be 19·2, 16·6, 18·6, 14·5, and 29 in the case of the five minerals in the order given. Reproductions of photographic plates exposed to the different minerals for the same time are also given. L. H. W.

1874. *Radio-activity induced by Uranium.* **H. Becquerel.** (Comptes Rendus, 141. pp. 87–90, July 10, 1905.)—Barium sulphate precipitated in a solution of uranium chloride is at first more active than uranium, but gradually loses its activity, which decays to half value in 20 to 24 days; the activity of the uranium in solution is proportionally reduced, but gradually rises to its normal value. The behaviour of this precipitate is so closely analogous to that of the gaseous emanation from radium salts that experiments were made to test the behaviour of this gas towards barium sulphate. It was found that the emanation from a solution of radium chloride, collected during 6 days in distilled water, was carried down completely by barium sulphate, giving an inactive solution and a precipitate 18 times as active as black oxide of uranium. The activity disappeared in a few hours, falling to half value in 30 min.—a period corresponding with that of the gaseous emanation. An active product was also obtained by boiling lamp-black with a solution of 50 gm. of uranium bromide and burning off the carbon. The residue was more active than the unburnt lamp-black, and increased in activity during 8 days, until, in spite of the minute quantity present, it was as active as 1·320 gm. of black oxide of uranium. T. M. L.

1875. *Radio-activity of the Boracic Suffioni of Tuscany.* **R. Nasini, F. Anderlini,** and **M. G. Levi.** (Accad. Lincei, Atti, 14. pp. 70–76, July 16, 1905.)—The radio-activity of a great number of the suffioni has been determined. The gases are collected and tested for radio-activity in the ordinary way, a careful chemical analysis being made in all cases. The radio-activity does not appear to depend upon the composition of the gases but upon the strata through which they have passed. From measurements of the rate of decay of the activity, and the fact that activity is induced in metal wires, it is concluded that it is the emanation from radium that is present. On removal of the CO_2 and SH_2, which constitute about 94 per cent. of the gas, the activity is increased about 20 times, the whole of the emanation remaining in the residue. The residue is then placed in a U-tube and cooled by liquid air, the emanation being thereby completely condensed. The gas with it is displaced by a stream of oxygen, which is absorbed by copper, heated in a small side tube which is then sealed off. In the case of the suffioni of Larderello, 1 cub. m. of gas contains about 1·5 × 10^{-5} cub. mm. of emanation. S. G. S.

1876. *Radio-activity and Occurrence of Radium in Australian Minerals.* **D. Mawson** and **T. H. Laby.** (Chem. News, 92. pp. 39–41, July 28, 1905. From Journ. and Proc. (vol. 38) of the Roy. Soc. of N.S. Wales.)—Only two occurrences of uranium minerals appear to have been recorded in Australia; both of these, a *euxenite* and a *torbernite*, were found to be highly active, but the quantity was insufficient for a comparative test. In addition to a feebly active *gadolinite*, the only active minerals found were *monazite* sands from different sources, which showed a radio-activity ranging from 2 to 11 per cent. of that of black oxide of uranium U_3O_5, or 1 to 3 per cent. of that of Joachimsthal pitchblende. Radium was tested for in four of the minerals by heating them in a vacuum and testing the rate of decay of the radio-activity of the resulting gas. The gadolinite in which Collie found a small amount of helium gave no radium emanation, although it was radio-active; the mineral was found, however, to contain traces of thorium, and this may be the source of the activity. One only of the monazites gave a definite radium emanation.

T. M. L.

1877. *Radio-active Properties of the Waters of the Arkansas Hot Springs.* **B. B. Boltwood.** (Amer. Journ. Sci. 20. pp. 128–132, Aug., 1905.)—Although these springs lie close together, the activity of the waters varies in the ratio 500 : 1. The more active springs are widely scattered, and adjacent springs usually differ completely in their radio-active properties. The two cold springs are much more active than the least active of the hot springs; the thermal and radio-active properties are due to quite independent causes.

T. M. L.

1878. *Action of Radium Emanations on Minerals and Gems.* **C. Baskerville** and **L. B. Lockhart.** (Amer. Journ. Sci. 20. pp. 95–96, Aug., 1905. Paper read before the Washington Sect. of the Amer. Chem. Soc., April 6, 1904.)—A brilliant glow was observed when the emanation from radium chloride was condensed on wollastonite, willemite, greenockite, and tiffanyite (Dutch diamonds). It was observed, on frequent repetition of the experiment, that kunzite, which is so responsive to radium, neither fluoresced nor phosphoresced when the emanations were condensed thereon; it is, therefore, responsive to the β- and γ-rays only. [See also Abstract No. 303 (1904).]

T. M. L.

1879. *Radio-activity of the Euganean Thermal Springs.* **G. Vincenti** and **M. Levi da Zara.** (Real. Istit. Veneto, Atti, 64. pp. 95–110, 1905.) **G. Vincenti.** (Ibid. pp. 535–547.) **G. Vincenti** and **R. Alpago.** (Ibid. pp. 1187–1232, 1905.)—The authors have examined the mud, sinter, fango, and gas from several sources, and the experiments, mostly made with Elster-Geitel type apparatus, are detailed at length. The results overlap to some extent, but the following is a brief summary. The mud and sinter from the springs of Abano, Battaglia, and Montegrotto, as well as of the lake of

Lispida, show a radio-activity about 3 to 10 times that of Wolfenbüttel earth, as given by Elster and Geitel. With the fango from Montegrotto, it was found that with small quantities the radio-activity increases rapidly (but not proportionally) with the amount, but above 450 gm., corresponding to a layer 25 mm. thick, no increase is observable. A large amount of emanation is given off, the induced activity produced by which follows the law of Curie and Danne after the first 30 min. (For the first 8–10 min. the decay is more rapid.) A similar behaviour is shown by the emanation from the Abano and Battaglia springs. Gas from the former of these showed that decay to half value took 3·67 days when measured by Rutherford and Soddy's method. A wire kept at a high temperature during activation was observed to acquire a greater activity than under ordinary circumstances. L. H. W.

1880. *Radio-activity of Russian Mineral Waters, Muds, and Soils.* **A. P. Sokoloff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 4. Physics Section, pp. 101–150, 1905. From the Phys. Inst. of Moscow Univ.)—The author has studied the radio-activity of the gas (chiefly carbonic acid gas) liberated at the Narzan spring at Kislowodsk (Caucasus). This gas 4 days after its extraction showed an ionisation 300 times that of the normal gas. The activity gradually decayed according to an exponential law ascertained by daily observations with a specimen of the gas extracted 20 hours before. The time constant λ in the law referred to ($I = I_0 e^{-\lambda t}$) is equal to (1/357000) sec.^{-1}, corresponding to a period, θ, of 2·86 days for the reduction of the activity to half value. In another experiment the value 3·12 days was found. Two experiments were made on the radio-activity induced in a brass network plunged for 2 h. 20 min. in the Narzan gas and charged negatively. The curves which express the loss of activity are in almost complete accord with those obtained by Curie and Danne, and by Dadourian for the induced radium radio-activity. In a number of other springs the presence of emanations similar to those of radium is indicated, but with the possible exception of the Elisabeth spring at Piatigorsk they do not contain radio-active substances. Seven medicinal muds, from the east and south of Russia, studied were found to be radio-active; the mean value of θ (which was only determined roughly) was found 1½ times less than in the case of the Narzan emanation. Fifteen different kinds of non-medicinal muds and Russian soils were examined; they were all radio-active (except one). D. H. J.

1881. *Charge carried by the α- and β-Rays of Radium.* **E. Rutherford.** Phil. Mag. 10. pp. 193–208, Aug., 1905.)—A brief account of the results of this paper has already appeared in *Nature* [see Abstract No. 747 (1905)]. The charge on the α-rays is detected by methods already given. The total charge emitted by a known weight of radium bromide, and carried by the α-rays, is measured by a comparatively simple method, and assuming the charge on each α-particle is ionic, it is deduced that 1 gm. of radium bromide at its minimum activity expels $3{\cdot}6 \times 10^{10}$ particles per sec. Assuming the formula $RaBr_2$, the number for pure radium at its minimum activity is $6{\cdot}2 \times 10^{10}$. The number from 1 gm. of radium in radio-active equilibrium is four times this amount, and is equal $2{\cdot}5 \times 10^{11}$. This is in good agreement with the number 2×10^{11} previously deduced from the heating effect. It has been suggested that the α-particles are uncharged at the moment of expulsion. In these experiments the charge they carry is independent of the state of the vacuum over a considerable range, and this would not be expected if they gain their charge by collision and consequent loss of an electron. The experiments show that the slow-speed electrons discovered by J. J. Thomson arise, not only from the plate upon which the radium is spread, but also, in less amount, from that into which the α-rays are shot. Whether any come from the salt itself, or whether they all arise from the bombardment of the plate by the α-rays is not settled. By a method similar to that used for the α-rays, the number of β-rays expelled per sec. from 1 gm. of radium is found equal to $7{\cdot}3 \times 10^{10}$. Reasons are given why this number may probably be too high. The results indicate that four α-particles are expelled from radium in equilibrium for each β-particle. Knowing the number of α-particles expelled per sec., the magnitude of other important physical constants in radio-activity may be deduced. Thus the time for radium to be half transformed is calculated to be 1,280 years. The maximum volume of the emanation to be obtained from 1 gm. of radium in equilibrium is 0·83 cub. mm., while Ramsay and Soddy found experimentally about 1 cub. mm. The emission of energy in the form of α-particles is calculated to be 126 gm.-cals. per gm. per hour, in good agreement with the 100 found by Curie and Laborde. The number of ions produced by an α-particle per cm. of path at a pressure of 1 mm. is deduced to be 38, or nearly twice as many as Townsend found for an electron. The energy required to produce an ion in air is equivalent to that acquired by the ion falling freely through 24 volts. R. S. W.

1882. *Experiments with Radio-active Substances.* **E. H. Bowen.** (West. Electn. 37. p. 125, Aug. 12, 1905.)—Some experiments on the rate of collapse of the leaves of an electroscope, produced by various radio-active substances are briefly described, but the results are mostly qualitative. A table is further given of the rate of collapse produced by radium bromide through various substances which are used as commercial insulators—fibre, asbestos, paper, cardboard, &c. L. H. W.

1883. *Gaseous Products from Actinium.* **A. Debierne.** (Comptes Rendus, 141. pp. 383–385, Aug. 14, 1905.)—Using a solution containing about 0·1 gm. of radium bromide, the author has been able to confirm the observations of Ramsay and Soddy with reference to the liberation of helium. The helium was mixed with a small amount of argon probably derived from air contained in the apparatus, but when samples of gas were drawn off a large number of times from the same solution during a period of 6 months without allowing access of air, the amount of argon became less and less, whilst the helium was produced quite regularly. A solution of actinium chloride was found, like radium chloride, to liberate large volumes of H and O, and the presence of He could be clearly detected even when the solution had been specially treated with barium chloride to remove all traces of radium. The amount of helium liberated appeared to be comparable with that obtained from a radium salt of equal activity. Helium was also obtained from the dry peroxide of actinium, but control experiments, *e.g.*, with the gas obtained by electrolysing water, gave always negative results. In these experiments the nitrogen was absorbed by means of metallic lithium. T. M. L.

1884. *Simple Method of showing the Presence of Helium formed from Radium Bromide.* **F. Giesel.** (Ber. Deut. Chem. Gesell. 38. pp. 2299–2300, July 8, 1905. Chem. News, 92. p. 77, Aug. 18, 1905.)—Anhydrous radium bromide (50 mgm.) was put into each of two Geissler tubes with Al electrodes and exhausted as completely as possible. The first tube (capacity 5 cub. cm.) contained salt

heated below its melting-point, the second tube (15 cub. cm.) contained fused salt. After 2 months the D_3 line was seen in the first tube, and after 6 months four other lines were seen; the second tube showed only the D_3 line.
T. M. L.

1885. *Rate of Formation of Radium.* **R. J. Strutt.** (Nature, 72. p. 365, Aug. 17, 1905.)—Soddy has found that radium is continuously produced in uranium, but that the rate of production is only 1/1000th of the theoretical amount [see Abstract No. 1585 (1905)]. The explanation of this discrepancy, which has been suggested by Soddy and others, is that there may be one or more intermediate products. This product must therefore be present in pitchblende; hence if all the radium be removed, but as little else as possible, from a solution of the mineral, an increased rate of production of radium ought to be observed. A solution was thus made and the radium removed, but not wholly, by alternate addition of barium nitrate and potassium sulphate. The rate of production of radium is much greater than in Soddy's experiments, but the test has not proceeded long enough to give conclusive results.
R. S. W.

REFERENCES.

1886. *Quartz Spectrograph for Astrophysical Work.* **J. Hartmann.** (Zeitschr. Instrumentenk. 25. pp. 161–167, June, 1905.)—The author gives a description of a quartz spectrograph recently made for use with the 80-cm. refractor of the Potsdam Observatory, with numerous suggestions on points of efficient design, and tabulations of the corrections for colour, &c. The instrument is adapted for both visual and photographic determinations.
C. P. B.

1887. *Temperature Corrections for Use with the Abbe Refractometer, and Refractive Indices of some Oils.* **T. F. Harvey.** (Soc. Chem. Ind., Journ. 24. pp. 717–718; Discussion, p. 718, July 15, 1905.)

1888. *Coloured Screens for the Isolation of Groups of Special Radiations.* **F. Monpillard.** (Comptes Rendus, 141. pp. 31–33, July 3, 1905.)—The method depends upon the coating of glass plates with films of gelatine of definite thickness and containing definite amounts of colouring matter.
E. C. C. B.

1889. *Electrical and Spectral Properties of the Arc Discharge.* **J. Stark** and **R. Küch.** (Phys. Zeitschr. 6. pp. 438–443, July 15, 1905. Communication from the Wissenschaftl. Laborat. von W. C. Heraeus in Hanau, June, 1905. Écl. Électr. 44. pp. 303–306, Aug. 26, 1905.)—Some observations upon the properties and the line and band spectra of the arc discharge between electrodes of the metals Cd, Zn, Pb, Bi, Sb, Te, and Se in quartz tubes which were highly exhausted. The authors claim that they support the views already put forward that line spectra are given by the ions, and band spectra by the process of recombination between ions and electrons to form the neutral atoms or molecules [see Abstracts Nos. 2883 and 3250 (1904)].
E. C. C. B.

1890. *Radio-activity of Mineral Oils and Natural Gases.* **J. C. McLennan.** (Internat. Elect. Congress, Trans. 1. pp. 398–422, 1904.)

1891. *Radio-activity of the Air, Earth and Water at Halle.* **R. Schenk.** (Jahrbuch d. Radioakt. und Electrotonik, 2. pp. 19–41, 1905. Beibl. Ann. d. Physik, 29. 11. pp. 586–587, 1905. Abstract. From Halle Dissertation, 1904.)

1892. *Action of Wood on Photographic Plates.* **C. W. Raffety.** (Knowledge, 2. p. 148, July, 1905.)—The author states that, using a very sensitive screen, he has observed a bombardment from a piece of white fretwood, the scintillations being as bright as any he has seen with uranium, pitch blende, polonium, or even radium, but only coming singly, or now and again in twos and threes, with considerable intervals. L. H. W.

1893. *Action of Radio-active Bodies on Gelatine Media.* **J. B. Burke.** (Nature, 72. p. 294, July 27, 1905.)—The writer notes that experiments similar to his own on this subject [see Abstract No. 1399 (1905)] have been independently carried out by B. Dubois, who stated in a speech at Lyons last November that he had obtained some microscopic bodies by the action of radium salts on gelatine bouillon which had been rendered "aseptic." J. J. S.

1894. *Radio-activity of Springs of the Southern Viennese Thermal Line.* **H. Mache** and **S. Meyer.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 545–551, May, 1905. From the II. Phys. Inst. and the Inst. f. theoret. Physik der k.k. Univ. in Wien.)—The authors have examined some springs at Fischau, Vöslau, and Baden in the same way as in the case of the Bohemian springs [see Abstract No. 1395 (1905)]. All contain about the same ratio of emanation content for equal volumes of water and gas, but the activity of the Baden waters is much greater than in the other cases, in which it is very slight. Henrich's results [Abstract No. 1010 (1905)], relating to the Wiesbaden springs, are criticised. L. H. W.

1895. *Radiation Action on Photographic Plates.* **O. Stöckert.** (Ann. d. Physik, 17. 1. pp. 192–195, June 9, 1905.)—Remarks upon W. Merckens' paper [see Abstract No. 1213 (1905)]. The author considers that the effects are not due to vapour from hydrogen peroxide, but are produced by material particles or ions sent out from the hydrogen peroxide surface in straight lines, and perhaps analogous to radium radiation. J. J. S.

1896. *Properties of Radium in Small Quantities.* **A. Voller.** (Phys. Zeitschr. 6. pp. 409–411, July 1, 1905.)—The author maintains, against Eve, that his conclusions that the life of radium depends on the amount tested are correct. [See also Abstract No. 1223 (1905).] R. S. W.

1897. *Decay Constant of Radium Emanation.* **O. Sackur.** (Ber. Deut. Chem. Gesell. 38. pp. 1753–1756, May 6, 1905. Chem. News, 92. pp. 28–29, July 21, 1905.)—The author has redetermined the decay constant for the emanation. He finds $\lambda = 2{\cdot}08 \times 10^{-6}$ secs. $= 3{\cdot}86$ days, which is the mean of the values given by Rutherford and Soddy and Curie. R. S. W.

1898. *Effect of Radium on the Strength of Threads.* **H. P. Martin** and **W. B. Morton.** (Nature, 72. p. 365, Aug. 17, 1905.)—In the case of silk fibres the loss of strength goes on uniformly during the whole time of exposure (seven days). The strength of cotton threads decreases more quickly in the early stages. The effect seems to be entirely due to the *a*-rays. [See also Abstract No. 1070 (1904).] R. S. W.

1899. *Influence of Radium Emanation on Bacteria.* **E. Dorn, E. Baumann,** and **S. Valentiner.** (Phys. Zeitschr. 6. pp. 497–500, Aug. 15, 1905.) R. S. W.

HEAT.

1900. *Thermal Expansion of Hydrogen and Carbon Dioxide under Constant Pressure.* **T. W. Richards** and **K. L. Mark.** (Amer. Acad., Proc. 41. No. 6. pp. 117–140, June, 1905. Contribution from the Chem. Lab. of Harvard College.)—Employing the same apparatus as in the previous investigation [see Abstract No. 899 (1903)], but with improvements in its surroundings, stability and manipulation, the coefficient of expansion found for hydrogen is 0·0036609, and for carbon dioxide 0·0037282. The importance in such determinations of a knowledge of the amount of absorption of gases by glass is pointed out, and the possibility of measuring the pressure of a gas to an accuracy of 1/1000 mm. of mercury is shown. W. H. Sr.

1901. *Determination of Melting-points at Low Temperatures.* **L. F. Guttmann.** (Chem. Soc., Journ. 87. pp. 1037–1042, July, 1905.)—For measuring low melting-points, the author uses junctions of constantan (0·5 mm. thick) and copper (0·27 mm.) wires, the latter doubly covered with cotton. 2 cm. of the bared copper wire are melted round the constantan in a smoky blowpipe flame and the joint cooled in alcohol to prevent oxidation. One of these junctions is placed in the substance to be examined and another in melting ice, the free ends of the wires being connected to a sensitive galvanometer. The couple can then be calibrated by means of the melting- and boiling-points of ice, chloroform, a stiff paste of solid carbon dioxide and absolute alcohol, ether and liquid air. In making a determination the substance is placed in a long narrow tube (1·3 mm. wide), to form a layer about 1 cm. deep. This tube is fitted with a cork bored to admit a narrow glass tube, which reaches nearly to the surface of the liquid and down which the thermo-junction is passed. The substance is first frozen by immersing the tube in liquid air, the galvanometer being watched meantime so as to obtain an approximate idea of the melting-point of the substance. A mixture of equal parts of ether and ethyl bromide, placed in a cylindrical Dewar vessel 4 cm. diam. and 15 cm. high, is cooled to 5–10° below the melting-point to be measured, by stirring it with a test-tube containing liquid air. The melting-point tube is then placed in this bath, which is stirred by means of a perforated cardboard ring carried by two copper wires, the galvanometer being read every 30 sec. During fusion the temperature remains constant for 1·5–3 min. A number of melting-points determined in this way are given. T. H. P.

1902. *Effect of Current on Boiling-point.* **P. R. Heyl.** (Phys. Rev. 21. pp. 189–192, Sept., 1905.)—The temperature of boiling mercury when carrying a current of 100 amps. per sq. cm. is compared with that carrying no current, by means of a Pt-Cu thermo-couple, but no difference as great as 0·04° occurs. In the case of certain electrolytes carrying currents (0·05 amp. per sq. cm. with copper sulphate, 0·001 with acetic acid) the change is certainly not as great as 0·001°. [See also Abstract No. 119 (1905).] S. G. S.

1903. *Specific Heats of Metals at High Temperatures.* **N. Stücker.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 657–668, May, 1905. From the Physik.

Inst. der Univ., Graz.)—The method of mixtures is employed, the water calorimeter being slightly modified. The substance is contained in a cylindrical iron shell which is completely closed. Determinations are made with and without the substance in the shell. The calculation of the actual specific heat at any temperature, from the mean specific heat over a range of temperature such as is used in the experiment, is given. Tables of results for Fe, Mo, Mn, Mg, Bi, and Pb for temperatures up to 625° are included.

S. G. S.

1904. *Specific and Molecular Heats of Electrolytes.* **P. T. Muller** and **C. Fuchs.** (Comptes Rendus, 140. pp. 1639–1641, June 19, 1905.)—The authors have determined the specific heats of aqueous solutions of good and bad electrolytes by passing a constant current for a definite time through a glass spiral filled with mercury, and completely immersed in the liquid, and the molecular heats of the dissolved substances have been calculated therefrom, assuming the solvent water to retain the specific heat, unity. For good electrolytes the molecular heat diminishes with dilution, and may become negative, but with only moderate electrolytes the variation on dilution is at the most only very slight, as shown by experiments with methyl, ethyl, and propyl alcohols, formic, acetic, propionic, butyric, lactic and boric acids, ammonia and saccharose. This may be explained by accepting Puschl's suggestion that the specific heat of the combined water is less than that of water in the free state.

W. H. Si.

1905. *Heat of Vaporisation of Water.* **R. H. Hough.** (Amer. Journ. Sci. 20. pp. 81–92, Aug., 1905.)—The heat of vaporisation is determined directly in ergs. The method of applying the energy is similar to that used by Rowland in determining the mechanical equivalent of heat, but in this case the energy is converted into heat by means of a friction clutch which is situated in a vessel of water. The heat produced causes evaporation of water at 100° C., and from the loss in weight of the water in a given time and the rate of supply of energy the mechanical equivalent of the heat of evaporation can be found. The water substance being in a thermostatic condition, many of the errors of the older experiments are avoided. The observations have not yet been made.

S. G. S.

1906. *Thermo-electric Determination of Temperatures between 0 and 200° C.* **A. de Forest Palmer, Jr.** (Phys. Rev. 21. pp. 65–79, Aug., 1905.)—Describes experiments undertaken to determine the precision attainable in this interval with thermo-couples of commercial soft-iron wire and an alloy known as "advance," having composition and properties closely resembling constantan. The couples were tested at the temperatures of melting ice, the transition-point of sodium sulphate, and the boiling-points of distilled water, benzene, chlorobenzene, and aniline. The constant-temperature baths and boiling-point apparatus are described in detail. Trouble was at first experienced from residual thermo-electric forces in the potentiometer itself, and an auxiliary potentiometer was arranged by which these residual thermo-electric forces could be accurately balanced. The author finds, on reducing his results, that the relation between thermo-electric force and temperature is very nearly linear, and can best be expressed by an empirical formula of the third degree, giving a curve intermediate between a straight line and a parabola passing through 0 and 100; this formula, $T - \theta = \theta(\theta - 100)(P\theta - Q)$, where T is the true, and θ the "thermo-electric" temperature, P and Q being constants, cannot, however, be regarded as a true physical relation, since it gives three values of θ corresponding to every value of T, but it is convenient for reduction purposes. The authors conclude that within the range from 0 to 200° C. temperatures can be determined to within 0·04 per cent. by means of the iron-"advance" thermo-element when the residual thermo-electric effects are suitably eliminated. W. Ros.

1907. *Heat Insulation and Furnace Construction.* **R. S. Hutton** and **J. R. Beard.** (Faraday Soc., Trans. 1. pp. 264–269; Discussion, pp. 269–270, Aug., 1905. Chem. News, 92. pp. 51–54, Aug. 4, 1905. Elect. Rev., N.Y. 47. pp. 121–122, July 22, 1905.)—The paper describes a number of tests made with apparatus designed by C. H. Lees and J. D. Charlton for testing the heat conductivity of various substances. The authors made a number of tests with materials commonly used for insulating furnaces. Figures are given showing the conductivity at temperatures in the neighbourhood of 100° C. The authors point out that further tests at higher temperatures are needed to show results of shrinkage, &c., and these were made, not with absolute accuracy but quite comparable, by means of an electrically-heated tube-furnace, noting the energy consumed to maintain constant temperatures with different insulating materials. The authors' general conclusions are that the best insulation can be obtained for high temperatures by stratified insulation arranged in such a way that materials of good insulating power, such as infusorial earth, but which will not stand very high temperatures, are used outside more refractory insulators of less insulating value. J. L. F. V.

1908. *Explosions of Mixtures of Coal-gas and Air.* **L. Bairstow** and **A. D. Alexander.** (Roy. Soc., Proc. Ser. A. 76. pp. 340–349, Aug. 4, 1905. Page's Weekly, 7. pp. 362–365, Aug. 18, 1905. Abstract.)—Several series of experiments were carried out by the authors, using a specially designed explosion cylinder, the records being taken with an ordinary indicator. The mixtures were ignited by four simultaneous sparks. In some series the mixture was kept constant, and the initial pressure varied from ½ to 3 atmospheres. In others, the initial pressure remaining constant, the mixture was varied. The results are illustrated by diagrams and curves. In some, ripples are shown between the beginning of explosion and the time at which the maximum pressure is reached. They were eventually traced to sound-waves in the indicator tube, produced by the arrival of the flame at its open end. The authors conclude that mixtures of coal-gas and air are not inflammable until the volume of coal-gas is greater than 1/17th of the combined volumes. Only a very small fraction of the gas then burns, the amount burnt rapidly increasing with increased richness of the mixture until the coal-gas is 1/12th of the total volume. The least inflammable of the constituents then burns, and combustion becomes and remains complete so long as air is in excess. [See also Abstract No. 1022 (1903).] E. S. A. R.

REFERENCE.

1909. *Motion of Suspended Particles on the Kinetic Theory.* **A. Einstein.** (Ann. d. Physik, 17. 3. pp. 549–560, July 18, 1905.)—This paper treats the motion of small particles suspended in liquids, on the molecular-kinetic theory of heat. The author hopes that some experimenter will succeed in confirming the results thus obtained. [See also Abstracts Nos. 452 (1903) and 127 (1904).] E. H. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1910. *Electron Theory.* **H. A. Lorentz.** (Elektrotechn. Zeitschr. 26. pp. 555–560, June 15, and pp. 584–590, June 22, 1905. Paper read before the Elektrotechn. Verein, Berlin, Dec. 20, 1904. Écl. Électr. 44. pp. 121–140, July 29, and pp. 161–166, Aug. 5, 1905.)—A compact *résumé* of the results and problems of the electron theory. The following useful collection of numerical values occurs near the close of the paper :—

a = Kinetic energy of particle ÷ absolute temperature $= 1{\cdot}6 \times 10^{-16}$ ergs/degree.
Number of gas molecules per cub. cm. at 0° C. and standard pressure $= 3{\cdot}5 \times 10^{19}$.
Mass of hydrogen atom $1{\cdot}3 \times 10^{-24}$ gm.
Elementary electric quantity or element $= 1{\cdot}3 \times 10^{-20}$ electromagnetic c.g.s. unit.
Mass of a negative electron $= 7{\cdot}4 \times 10^{-28}$ gm.
Radius of a negative electron $1{\cdot}5 \times 10^{-13}$ cm. E. H. B.

1911. *Magnetic Effect of Electric Displacement.* **J. B. Whitehead.** (Phys. Rev. 21. pp. 111–121, Aug., 1905. Phys. Zeitschr. 6. pp. 474–480, Aug. 1, 1905. Écl. Électr. 44. pp. 426–430, Sept. 16, 1905.)—In two former papers the author described experiments undertaken to test the validity of Maxwell's assumption of the presence of a magnetic effect accompanying an electric displacement in a dielectric [see Abstracts Nos. 241 (1903) and 2255 (1904)]. The results of the experiments have been shown by Koláček [Abstract No. 1166 (1904)] to be in accord with Maxwell's theory. From the symmetry of the Maxwell equations we must also expect an electrical effect or force accompanying "magnetic displacement." Hence if the magnetic effect of electric displacement be granted, the experiments afford indirect proof of the existence of the electric effect of the "magnetic displacement current." The present work was undertaken to observe the two effects independently. The electric displacement again gave a magnetic effect of the right order as calculated from theory. But the modified arrangement, designed to observe the electric effect of magnetic displacement, gave only negative results. A subsequent calculation showed that the effect sought would give a deflection almost too small for detection. It is thus concluded that the method in question cannot be expected to afford evidence on the point under discussion. [See also Abstract No. 832 (1904).] E. H. B.

1912. *Note on H. A. Wilson's Paper on Electric Effect of Rotating Dielectric* **S. J. Barnett.** With Note by **Larmor.** (Roy. Soc., Proc. Ser. A. 76 pp. 367–369, Aug. 4, 1905.)—While admitting that Wilson's experiments confirm the electron theory of Lorentz, the present author objects to Wilson's interpretation of the theory in stating that, according to it, the electromotive force induced in an insulator with dielectric constant K, moving in a magnetic field bears the ratio $(K-1)/K$ to the electromotive force induced in a moving conductor [see Abstract No. 2256 (1904)]. It is here maintained that, as a matter of fact, it is not the induced intensity or electromotive force which differs from substance to substance, and which differs according to different theories, but the displacement or charge produced by this intensity or electromotive force. E. H. B.

DISCHARGE AND OSCILLATIONS.

1913. *Influence of Vapours upon a Current of Ionised Air.* **D. Pacini.** (Elettricista, Rome, 4. pp. 177–178, June 15, 1905.)—Experiments with ionised air alone or mixed with alcohol vapour show that the former has the greater coefficient of recombination, due either to a greater resistance to the movement of the ions or, more probably, to an increase in the mass of the ions themselves. Recombination of the ions is also retarded by causing the air to pass over a solid odorous substance such as menthol. W. H. Sı.

1914. *Negative-brush in Air.* **W. Holtz.** (Ann. d. Physik, 17. 2. pp. 353–358, July 4, 1905.)—In the experiments described an influence machine was used giving a 20-cm. spark. Three distinct types of brush were obtained, of which illustrations are given. (1) Thin, long-stemmed brush (accompanied by a high-pitched sound), having a reddish middle line in the stem, with fine hair-like ramifications along the entire length. The greatest length was reached when the sparking knobs were 7–9 cm. diam. The stem has a green middle line if coal-gas is used. (2) Short-stemmed brush with side branches (accompanied by a sound of lower pitch) obtained when the discharge passes through a considerable thickness of tissue-paper. (3) Stemless brush with very many ramifications—obtained best with a glass plate having a hole bored through it electrically, through which the brush is allowed to pass. A. W.

1915. *Dielectric Cohesion of Gases.* **E. Bouty.** (Comptes Rendus, 141. pp. 312–314, July 31, 1905.)—The author's formula is $y = a\sqrt{p(p+b)}$, where y is the critical value of the electrostatic field which will cause a glow-discharge to pass, a is the dielectric cohesion of the particular gas, p is the pressure (above 0·1 mm. Hg), and b a constant varying with the apparatus and with the gas used (influence of the dielectric walls or of the adherent gaseous layer); and this formula he now finds can be written $y = a\sqrt{p(p + k/e)}$, where e is the distance between the terminals of the field in the gas, and k is a constant dependent only on the nature of the gas. The difference of potential necessary to produce a discharge thus becomes $Y = ey = a\sqrt{pe(pe + k)}$, in which pe corresponds to the mass of gas acted upon. For considerable masses of gas this curve may be taken as its asymptote, $Y = ak/2 + ape$; the difference of potential required presents two terms, $ak/2 =$ about 1,760 volts for air, 1,350 volts for hydrogen, and $ape =$ for air about $2{\cdot}46 \times 10^7$ volts per gm. of air traversed per sq. cm. of cross-section. The value of y in the above equation tends to zero as p falls off; and the term belonging to the gas itself certainly does become very small at minimal pressures: at pressures below 1/25 mm. the required field sinks to 8 or 9 volts/cm., only some six times greater than the mean electrostatic field of the earth itself; whence at high altitudes the terrestrial electrostatic field itself should cause a discharge in the atmosphere, and at these altitudes the atmosphere should normally be ionised so as to annul the electrostatic field at still higher altitudes. [See also Abstract No. 2454 (1904).] A. D.

1916. *Nernst Filaments.* **C. I. Zimmerman.** (Amer. Electrochem. Soc., Trans. 7. pp. 79–81, 1905.)—It is pointed out that besides electrolytic conduction, actual electrolysis takes place; low-current densities and reversal of polarity both conduce to shortened life [see Abstract No. 958B (1905)]. Experiments are described showing that, using an exploring electrode, the conductivity produced in air by the filament is almost entirely confined to the kathode region, although the anode temperature is much greater. A 200-volt alternating-current glower can produce a deflection corresponding to 250 volts on a Kelvin multicellular electrostatic voltmeter connected to the exploring wire, due to a unidirectional static charge received when the wire is near the momentarily negative electrode of the glower. The resemblance to the phenomena noticed in connection with unsymmetrical electrolytic condensers is referred to. [See Abstract No. 1933 (1905).] L. H. W.

1917. *Conduction of Electricity through Gases between Parallel Plates.* **A. A. Robb.** (Phil. Mag. 10. pp. 237–242, Aug., 1905.)—The differential equation for the electric intensity between the plates in terms of the rate of ionisation, charge on the ion, rate of recombination and velocities of positive and negative ions in unit field given by J. J. Thomson (see "Conduction of Electricity through Gases," p. 66), has only been solved when the positive and negative ionic velocities are equal; but the author shows that there is a solution when the pressure has one of two values corresponding to $a = 4\pi e R_1$ and $a = 4\pi e R_2$, a being the coefficient of recombination, e the charge on the ion, and R_1 and R_2 the respective velocities under unit electric intensity. In the case of air these pressures are 1·53 and 1·83 atmospheres. In obtaining this result the equation is transformed before integration, and in one form it does not involve strength of current or intensity of ionisation, and is therefore characteristic of the gas. S. G. S.

1918. *The Singing Arc.* **A. Blondel.** (Écl. Electr. 44. pp. 41–58, July 15, and pp. 81–104, July 22, 1905. Also Comptes Rendus, 140. pp. 1680–1682, June 26, 1905.)—The full papers referred to above are very elaborate, containing diagrams, tables, and over 150 curves obtained by the oscillograph and representing the current in the arc under different conditions. The known facts are reviewed and the whole subject very carefully examined qualitatively. Two extreme types of oscillograph curves and singing arcs are recognised, namely those of a regular, simple, musical character, and those of a more complicated, hissing, or strident character. After the introduction, the body of the paper consists of four parts dealing respectively with: (1) The general phenomena with homogeneous carbons; (2) Relations between the hissing arc and high-tension oscillatory discharges; (3) Production of the singing arc with cored or mineral carbons; (4) Singing arc between metal and carbon. Then follow the results obtained, the chief of which may be stated thus: (I.) There are two different types of singing arc, continuous and discontinuous. The continuous phenomenon seems to obtain only when the gas is ionised. (II.) The discontinuous phenomenon is the more general case, for it obtains with electrodes either of carbon or metal. (III.) The frequency of the singing arc is essentially variable and ill-defined. (IV.) The conditions of supply and especially the pressure used play a very important part. The addition of a sufficient impedance in the supply circuit may produce an inversion of the current in a low-pressure arc.

E. H. B.

1919. *Residual E.M.F. of Carbon Arc.* **G. G. Becknell.** (Phys. Rev. 21. pp. 181–188, Sept., 1905. Paper read before the Amer. Physical Soc., April 21, 1905. Elect. Rev., N.Y. 47. p. 398, Sept. 9, 1905. Ind. Élect. 14 pp. 414–416, Sept. 25, 1905.)—After the carbons have attained a steady temperature, the source of e.m.f. is removed and the e.m.f. across the arc, and the current (with 1,000 ohms in series) are measured at successive intervals of time. Appreciable effects are observed for 10 sec. after interrupting the main current. The e.m.f. is in the direction counter to that of the dynamo which maintained the arc; both e.m.f. and current rise for about ¼ sec. and then steadily fall. The maximum e.m.f. is 0·65 volt and current 0·55 milliamp. The author shows that the effect is not a thermoelectric one, and he concludes that it is due to the difference of temperature of the carbons; the positive carbon being at a much higher temperature than the negative, it emits negative ions at a greater rate than the negative carbon. With graphite carbons, which have higher heat conductivity, the effect is much smaller, as is also the case with the alternating-current arc. S. G. S.

1920. *New Discharge Phenomena.* **J. R. Januszkiewicz.** (Phys. Zeitschr. 6. pp. 531–536, Sept. 1, 1905.)—Using a Voss machine and two spherical sparking knobs, experiments are performed in which the position of the sparks and its character are altered by the presence of non-conducting and partially conducting bodies. The sticking of small, partially-conducting bodies to the positive terminal and the effect of placing one on the negative terminal are then described, and also the equilibrium of a suspended conducting sphere placed in the field. Several experiments with the brush discharge are then given. S. G. S.

1921. *Damping in Condenser Circuits having a Spark-gap.* **G. Rempp.** (Ann. d. Physik, 17. 4. pp. 627–657, Aug. 22, 1905. Amplification of Strassburg Dissertation.)—The author has made an exhaustive investigation of the damping in spark-gap containing-condenser circuits since recent results were considered by him not to furnish sufficient data for practical wireless telegraph purposes. Bjerknes' resonance method, as employed by Drude [see Abstract No. 166 (1905)], was chosen, the apparatus being arranged so as to have a very low metallic resistance, and the coupling being very weak. The preliminary experiments and precautions are fully discussed, and the experimental results given in tables and curves. The following is a summary of the chief points, which in some cases are opposed to and in others in agreement with previous work. (1) In all practical cases almost the whole of the damping and apparent resistance of a condenser circuit is due to the spark (and energy absorption in the condensers ?). The smallest value of the logarithmic decrement, γ, found was 0·060, the smallest "total resistance" $\omega = 0·52$ ohm. (2) With increasing spark-length, γ and ω both diminish at first to a minimum at 0·3 cm. for small capacities and at 0·6 cm. for capacities of 0·001 to 0·008 mfd.; on further increasing the spark-length (to 5 cm.), γ increases almost linearly. But with larger capacities, ω increases so slowly that even with much greater spark-lengths little loss of efficiency occurs. (The effect in a loosely coupled system, it is pointed out, in some cases only reaches a maximum at much greater spark-lengths.) (3) With increase of capacity (278×10^{-6} to 6860×10^{-6} mfd.), γ diminishes, at first rapidly and then slowly, to increase again from 0·008 mfd. upwards. ω, on the other hand, continually decreases, though from 0·001 mfd. only comparatively slowly; the increase of ω with spark-length is much less rapid with large than with small capacities. (4) Increase of self-induction (2660 to 18,100 cm.) has little influence on γ; so that $\omega \propto \sqrt{L}$ nearly. (5) Added resistance, ω_1, produces an increase in ω greater than the mere addition of ω_1 to ω; the difference, $\omega - \omega_1$, the spark resistance, increases therefore with ω_1. Spark balls of 1·5–5 cm. diam. give the same results up to 1 cm. spark-length; above this γ increases more rapidly with balls of larger diam. (7) But with larger balls the discharge potential, V, increases in quite a different way, so that the current effect with large balls increases longer and rises to a higher maximum. (8) Charging the condensers by an influence machine gives the same value for γ as with the coil, and gives good results. The above conditions apply only to the case of *very* weak coupling, as was here employed. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1922. *Dielectric Strength of Conducting Liquids.* **A. Heydweiller.** (Ann. d. Physik, 17. 2. pp. 346–352, July 4, 1905. Phys. Inst. d. Univ., Münster, April, 1905. Écl. Électr. 44. pp. 341–343, Sept. 2, 1905.)—Experiments were carried out by means of the spark discharge on solutions of salts and acids in water. The results indicate that an increase of the conductivity is connected with a decrease of the dielectric strength of water towards rapid changes of potential, and that this diminution takes place rapidly with smaller conductivity and with higher is strongly retarded. It appears that this decrease is determined only by the raising of the conductivity; a specific influence of the dissolved substance is not demonstrable. The dielectric strength of pure water is about 9 times as great as that of normal air. J. J. S.

1923. *Resistance of a Coherer Contact.* **A. Blanc.** (Annal. Chim. Phys. 5. pp. 433–470, Aug.; and 6. pp. 5–81, Sept., 1905.)—A thin cover-glass is silvered lightly and clamped in a frame. A polished steel ball is brought near it so that Newton's rings are formed by monochromatic light falling on them, and the rings are viewed by a microscope. The rings show the distance between the surfaces; coherence can be produced between the surfaces at the centre of the ring system, and the resistance of the coherer is shown on a circuit including a galvanometer. The author's conclusions from using this apparatus are: (1) No small steady current passes before contact is made. (2) The dielectric does not play an essential part in coherence. (3) There is no bridge formed and no fusion between the surfaces. (4) Neither ultra-violet light nor Röntgen rays nor radium action produce a change in the resistance of a coherer contact. (5) Neither oxide nor condensed gases play an important part in coherence phenomena. P. E. S.

1924. *Temperature Coefficient of Carbon.* **H. Morris-Airey** and **E. D. Spencer.** (Manchester Lit. and Phil. Soc., Mem. 49. 10. pp. 1–8, Aug. 4, 1905.)—The temperature range is between 0° and — 200° C. on the platinum scale. A Dewar flask contains a thick brass cylinder, inside which is a carbon filament and a long platinum wire in a helix. The filament is of the kind used in glow lamps and has resistance about 1,000 ohms. The platinum temperature is found in the usual way by the resistance of the platinum helix. The helix and filament are each connected to leads, and liquid air is a perfect insulator for both of them. The process is to pour liquid air into the flask, the carbon resistance increases and the platinum resistance decreases, each finally becoming steady; the liquid air is then poured away and the two resistances are read simultaneously as the temperature slowly rises to about 0° C. The specific resistance of carbon is about $4{\cdot}6 \times 10^6$ at — 180° and $4{\cdot}4 \times 10^6$ at 0°. The curve connecting specific resistance with platinum temperature is straight except between — 150° and — 180°, where there is a small but distinct depression in the curve. P. E. S.

1925. *Synchronous Rotations Obtained by Means of Selenium Cells.* (Elect. World and Engineer, 46. p. 342, Aug. 26, 1905.)—The arrangement described is the invention of P. Ribbe. The two discs to be driven synchronously are rotated by clockwork at approximate synchronism. Each disc has a number of radial slits and an equal number of soft-iron armatures acted on by an electromagnet as they pass its pole. The winding of the magnet at either station is connected in series with a battery and a selenium cell at the other station. The selenium cell is placed behind the disc, and in front of the disc is placed a lamp. Each time a slit passes the selenium cell the latter receives a flash of light, and allows current to pass through the coil of the synchronising magnet at the other station, exact synchronism being thereby secured. A. H.

1926. *Resistance as a Measure of the Current in a Conductor.* **W. A. Price.** [Experimental work by C. H. Wright.] (Phil. Mag. 10. pp. 352–363, Sept., 1905. Communicated by the Physical Society.)—Experiments were made to ascertain whether the resistance of a conductor is sufficiently accurately a measure of the current passing to serve the purpose of calibrating alternating-current instruments. The drop in a conductor carrying town alternating current was compared with the drop in a standard, by means of a Crompton potentiometer, the superimposed (measuring) direct current being chosen so small as not to influence the heating produced. The conductors used were (1) carbon filament lamps, (2) a Pt ligament in exhausted metal vessel, and (3) a similar ligament sealed in an exhausted bulb. The experimental arrangements are fully described, and as a result it is concluded that (1) might serve for measuring alternating currents of from 50 milliamps. up to, say, ½ or possibly 1 amp., but would not give results of a high degree of accuracy. With (2) it is found that the resistance for a given current increases very rapidly with the exhaustion when the latter is nearly perfect; and this property, it is suggested, would serve as a means of gauging high vacua. For (3) it is concluded that for the best results the exhaustion should be poor, or else the ends sealed in at a bright-red heat. For the accuracy obtainable reference should be made to the tables in the original. [See also Bedell, Abstract No. 1632 (1905).] L. H. W.

1927. *Measurement of Distributed Inductance and Capacity.* **L. Hermann.** (Ann. d. Physik, 17. 3. pp. 501–517, July 18, 1905. Physiologisches Inst., Königsberg, April 15, 1905.)—In a previous paper [see Abstract No. 3278 (1904)] the author has discussed the similarity between a nerve and a conductor having inductance and capacity distributed along it; the present paper is a discussion of a method of measuring such inductance and capacity. Two points of the conductor are brought to a given p.d.; the source of e.m.f. is removed and in its place a ballistic galvanometer is switched in and the throw observed. It is shown by considering the case of a number of condensers placed at intervals along the conductor, that the storage effect of this arrangement is equivalent to that of a capacity of 1/12 that which the condensers would have under ordinary static conditions; and, further, that by performing a similar experiment, using the conductor which connects the outside coatings of the condensers, the inductance is without effect. By observing the throws in the two cases both inductance and capacity can be found. Experiments are described. S. G. S.

1928. *Inductance and Capacity Measurements.* **W. J. Raymond.** (Phys. Rev. 21. pp. 90–110, Aug., 1905.)—This paper sets forth various methods for the measurement of self-inductance, mutual inductance, and capacity. Some of these are null methods, others require the measurement of ballistic deflections. The galvanometer used is fully described, but it is suggested that one of the d'Arsonval type, differentially wound [see Abstract No. 410 (1905)], may be found practicable. All of the methods employed—in all 22—are essentially comparisons between any two of the four quantities, resistance, self-inductance, mutual inductance, and capacity. Among separate measured values of the same quantity, agreement within 0·2 or 0·3 per cent. was reached, not only in one method but among several, and it appears that with care agreement within 0·1 per cent. may be attained. The author is convinced that the methods presented show some real gain in precision over those which make use of the Wheatstone quadrilateral and a ballistic galvanometer of the ordinary type. F. E. S.

1929. *Variation of a Capacity with Temperature.* **E. M. Terry.** (Phys. Rev. 21. pp. 193–197, Sept., 1905. Paper read before the Amer. Physical Soc., April 21, 1905.)—The bridge method for comparing capacities was used. Both capacities were placed in large water baths, the one being maintained at a constant temperature, while the temperature of the other was varied between 17° and 33° C. Owing to the large thermal capacity of the condenser it usually took about 48 hours for it to come to a uniform temperature throughout. An alternating-current galvanometer was employed, the instrument being a modification of that first used by Stroud and Oates [see Abstract No. 611 (1904)]. The outstanding difference in a set of measurements is about 0·005 per cent. The values of the temperature coefficients found for different capacities vary considerably, but are of the order — 0·02 per cent. per 1° C. rise in temperature. It is of sufficient magnitude to require consideration when used in measurements of high precision. F. E. S.

1930. *Billitzer's Method for Determining Absolute Potential Differences.* **H. M. Goodwin** and **R. B. Sosman.** (Phys. Rev. 21. pp. 129–146, Sept., 1905. Amer. Electrochem. Soc., Trans. 7. pp. 83–93, 1905.)—The theoretical importance of the questions raised by the results of Billitzer's investigation [see Abstract No. 148 (1904)] rendered a further verification of the experiments desirable. With this in view the authors undertook to repeat with all care the experiments described by Billitzer. In the experiments a minute metallic electrode is suspended in various solutions, and the deflection is observed when it is under the influence of an electric current. There are three forms of the experiment. (*a*) The deflection of a minute ball fused at the end of a fine wire and suspended in a liquid by a quartz fibre is noted. (*b*) The direction of migration of a colloidal metallic suspension is observed. (*c*) The potential difference produced at the ends of a tube of liquid when a metallic suspension is allowed to fall through the liquid, is measured. The present paper is devoted to experiments by the first method, and the results obtained have failed completely to confirm the measurements made by Billitzer. The authors are therefore forced to the conclusion that the method is not to be relied upon for the purpose for which it was developed. It would seem that most of the phenomena observed may be explained on the assumption of the negative migration of gaseous particles in the liquid, and as yet there are not sufficient grounds for rejecting the generally adopted values for the potential of the normal calomel electrode. This conclusion is further strengthened by the results obtained by Whitney and Blake [see Abstract No. 625 (1905)] in connection with an extended research on colloids. They fail completely to confirm those obtained by Billitzer, for it was found that the direction of migration of the metallic colloid could be varied at will by the addition of a greater or less amount of gelatine. F. E. S.

1931. *Mercurous Sulphate and Standard Cells.* **H. v. Steinwehr.** (Zeitschr. Instrumentenk. 25. pp. 205–208, July, 1905. Communication from the Physikal.-Techn. Reichsanstalt.)—The influence of the size of the crystals of mercurous sulphate on the e.m.f. of standard cells is considered in this paper. The mercurous sulphate of commerce is precipitated, and is usually found to consist of very fine crystals. Two samples of commercial sulphate were taken, the one by C. A. F. Kahlbaum and the other by E. Merck, and experiments showed that two cells constructed with these as depolarisers would differ in e.m.f. by 5×10^{-4} volt. Microscopic examination indicated that the finer-grained sulphate gave the higher e.m.f., and other experiments proved the observed difference in voltage to be wholly or mainly due to the difference in size of the crystals. Very large crystals of the salt were prepared by a precipitation method (the solution falling dropwise), at temperatures of 80 to 100°. With these large crystals and a second portion finely divided by pounding, a difference of 6×10^{-4} volt was obtained, thus proving the great influence of the size of the crystals. The author regards the hypothesis advanced by Carhart and Hulett [see Abstract No. 1277 (1905)], that the differences observed in samples of mercurous sulphate are due to the varying quantities of basic salt present, to be quite untenable. The concentration of a saturated solution of two salts, which are, moreover, in a state of interdependence, cannot depend on the absolute quantity of the solid base as would be the case on the supposition mentioned. Moreover, if solid mercurous sulphate is shaken with repeatedly renewed pure water, and the conductivity measured each time saturation is obtained, an equal value is indicated in each case until suddenly the conductivity of the solution drops considerably, all the normal salt having been converted into basic salt. Notwithstanding changing proportions, the concentration of the solution, and therefore its electromotive effect remain unchanged so long as undecomposed salt is present. The author is also inclined to regard the electrolytic method of preparing mercurous sulphate to be unsuited for the formation of crystals of uniform size. F. E. S.

1932. *Standard Cell of Low Voltage.* **G. A. Hulett.** (Amer. Electrochem. Soc., Trans. 7. pp. 333–339, 1905.)—All cadmium amalgams containing between 5 and 14 per cent. Cd have, when measured against any constant electrode, the same e.m.f. [see Jaeger, Abstract No. 943 (1898) and Bijl, Abstract No. 521 (1903)]. Amalgams between these percentages are made up of a solid and liquid phase, the solid appearing to be either Cd_3Hg_7 or a mixed crystal. These facts permit of the construction of a simple low-voltage cell represented by the scheme: Cadmium—cadmium sulphate—

cadmium amalgam (5 to 13 per cent.). The cells made are small in size and much like a thermometer. The cadmium electrode is deposited on platinum wire, the first combination being: Platinum—cadmium sulphate—cadmium amalgam. A current of 0·0005 to 0·002 amp. is passed, and about 20 mgm. of cadmium is deposited. The e.m.f. of this combination is 0·05175 int. volts at 20° C., the temperature coefficient being — 0·000244 per 1° C., and practically linear. The cell follows any ordinary temperature change as readily as a mercury thermometer, so that a constant-temperature bath is not required. The internal resistance is very small, but the cell polarises. F. E. S.

1933. *The Aluminium Electrolytic Condenser.* **C. I. Zimmerman.** (Amer. Electrochem. Soc., Trans. 7. pp. 309–331; Discussion, p. 331, 1905. Elect. Rev., N.Y. 46. pp. 813–816, May 20, 1905. Abstract.)—The paper forms a continuation of a preceding one [see Abstract No. 2964 (1904)], additional information being given. The specific resistance of the film is found in one case (tartrate solution) to be about 10^{11} ohms per cm^3. A value of 5×10^6 volts is obtained for the dielectric strength, five times that found by Mott [see Abstract No. 3259 (1904)], while the specific inductive capacity is now calculated to be only about 15, in place of 80 as was previously estimated. Owing to the p.d. being practically independent of the frequency, it is pointed out that a simple method of checking alternating-current voltmeters, when great accuracy is not required, is available. The alternating-current instrument is connected across the cell, and a direct-current voltmeter inserted between the carbon electrode and one of the Al plates, the first measuring the effective, and the second the average p.d. The unsymmetric cell (two Al electrodes of different capacity) is discussed and analysed graphically and mathematically. The "equivalent capacity" is $C_1C_2/(C_1 + C_2)$, where C_1 and C_2 are the capacities of the dielectrics. It is shown that the unidirectional p.d.'s across each electrode may be considerably greater than the impressed p.d. Two- and three-phase condensers are also discussed, and the p.d.'s of the latter shown diagrammatically. L. H. W.

1934. *Vacuum Thermo-element.* **H. Brandes.** (Phys. Zeitschr. 6. pp. 503–505, Aug. 15, 1905. Phys. Inst. der Univ., Strassburg, July, 1905.)—A thermo-element of constantan-iron is enclosed in an evacuated glass bulb with the junction at the centre of the bulb, the arrangement looking somewhat like a glow lamp. During evacuation the sensitiveness of the element increased eighteenfold, and the instrument can be used along with a sensitive pointer-galvanometer. It has, for certain purposes, an advantage over the bolometer, since it does not require an external source of current. The readings of the Siemens-Halske instrument employed were proportional to the square of the current strength. [See also Abstracts Nos. 472 (1902), 442 (1903), and 1628 (1905).] G. E. A.

1935. *New Interrupter.* **H. Gernsback.** (Scientific American, 93. p. 82, July 29, 1905.)—A 3-mm. bore glass U-tube immersed in a water vessel has its lower portion drawn out to form a capillary of $\frac{1}{8}$ mm. bore, and is then nearly filled with mercury. On passing a current through the mercury, the heat produced causes a breakage in the mercury thread, interrupting the current, which is automatically restored by the cooling which takes place when the circuit is broken. The interrupter works best with 4 to 6 volts, and gives out a high-pitched note. L. H. W.

ALTERNATING CURRENTS AND MAGNETISM.

1936. *Magnetic Susceptibility of Water.* **A. P. Wills.** (Phys. Rev. 20. pp. 188–189, March, 1905. Abstract of paper read before the Amer. Physical Soc.)—A rectangular vessel is weighed when empty and when full containing water, both in and out of a magnetic field; the mechanical force on the water due to the magnetic field is then calculable, and from it is determined the magnetic susceptibility of the water. This is practically constant. The following results were obtained at 18° C. :—

H	$k\times10^6$	H	$k\times10^6$	H	$k\times10^6$
4,190	−0·721	8,890	−0·718	12,530	−0·724
5,620	−0·720	9,520	−0·720	13,310	−0·718
7,430	−0·718	10,570	−0·718	15,310	−0·724

S. G. S.

1937. *Magnetic Ageing of Iron.* **D. Mazzotto.** (N. Cimento, 9. pp. 313–354, May, 1905.)—The author's theory of thermo-electric hysteresis is developed more fully than in his previous papers [see Abstract No. 2479B (1904)], and several new experiments to test that theory are described. It has been found that the effect of ageing reaches a maximum when this takes place at 131° C., the specimen having been previously made red-hot; the susceptibility is more affected by ageing, and the residual magnetism less, when the ageing is carried out at this temperature than below it. This may be due to the fact that the stable molecular condition below 131° corresponds to a greater susceptibility than at 131°, or that the stable condition is reached more slowly at low temperatures. In order to investigate this point, three specimens are aged at 131° C. and then at 62°, and it is found that the susceptibility is then less, and the residual magnetism greater, at 62° than at 131°. Hence the latter of the alternatives is the correct one. Weak fields (H = 6 is the upper limit) only are employed, since with strong fields the effect of ageing is too small to be observed. Experiments on "rebaking" (ricottura) are then described. This is the reverse of ageing (stagionatura). In the latter case the iron is first heated and then maintained for considerable time at a lower temperature, while in the former the iron is raised in temperature and maintained at this higher temperature for some time, its magnetic properties being measured at intervals. The "rebaking" is carried out at temperatures 131°, 159°, 180°. and 360°, and it is found that as the temperature rises the susceptibility increases with time and the residual magnetism diminishes, and that the changes take place much more rapidly than in ageing. At 360° the changes are practically complete in the first hour. The author then explains his results in the light of the molecular theory of magnetisation. There is a stable condition for each temperature; at higher temperatures the molecules are indiscriminately scattered, while at low temperatures they range themselves in closed circuits as described by Ewing. The lower the temperature the longer they take to arrange themselves in these circuits, and they are more stable when formed. Hence at low temperatures the ageing takes place very slowly, while on rebaking the breaking up of these circuits can take place rapidly. An explanation of time lag in magnetisation (magnetismo sussequente) [see Abstract No. 1488 (1900)] and its relation to the other magnetic properties is also given.

S. G. S.

REFERENCES.

1938. *The Mercury Vapour Lamp and Rectifier.* **M. Leblanc.** (Soc. Franç. Phys., Séances, 1. pp. 63–87, 1905. Soc. Int. Élect., Bull. 5. pp. 401–427, May, 1905. Rev. Électrique, 3. pp. 271–281, May 15, 1905.)—A lengthy paper dealing with the properties of the Cooper Hewitt lamp. [See also Abstract No. 1128 (1904).]

1939. *Wireless Telegraphy.* **W. B. v. Czudnochowski.** (Deutsch. Phys. Gesell., Verh. 7. 13. pp. 241–250, July 15, 1905.)—In continuation of the experiments described in Abstract No. 594 (1901) the author now investigates various methods of arrangement at the oscillator, and the relation between spark-length and resonance effect. R. A.

1940. *Specific Inductive Capacity of Oleic Acid and its Salts.* **L. Kahlenberg.** (Amer. Electrochem. Soc., Trans. 7. pp. 167–169, 1905.)—The following specific inductive capacities were observed at 20° C. : oleic acid, 2·59 (mean) ; cotton seed oil, 2·3 ; corn oil, 2·5 ; linseed oil, 3·25 ; rape seed oil, 2·35 ; palm oil, 2·4 ; colza oil, 2·7 ; ferric oleate, 2·68 ; aluminium oleate, 2·4 ; copper oleate, 2·8 ; sodium oleate, 2·75 ; lead oleate, 3·27. Thus oleic acid has the same dielectric constants as the glyceryl oleates ; the metallic oleates have only a slightly higher specific inductive capacity than oleic acid itself. D. H. J.

1941. *Standard for Röntgen Rays.* **G. Contremoulins.** (Comptes Rendus, 141. pp. 26–29, July 3, 1905.)—The instrument described in Abstract No. 1519 (1902) has been improved and now has added to it a photometric integrating arrangement, the principle of which is briefly referred to. L. H. W.

1942. *Gaiffe Mercury Interrupter.* (Électricien, 29. pp. 17–19, July 8, 1905.)—A rotating conical iron piece immersed in the mercury has a tunnel in it from the centre upwards to the periphery. The rotation causes the mercury to ascend and impinge against the fixed electrode.

1943. *Moments of Inertia of Vibration Magnets.* **W. Watson.** (Phil. Mag. 10. pp. 130–148, July, 1905. Communicated by the Physical Society.)—A description of a vibration apparatus which allows of the measurement of moments of inertia of small rods with great accuracy. In results the mean difference from the mean is about 0·0037 per cent. The effect of the air is considered and is found to produce an increase in moment of inertia of about 0·066 per cent. J. W. P.

1944. *Magnetic Hysteresis produced by a Superposed Oscillatory Field.* **P. Duhem.** (Comptes Rendus, 140. pp. 1216–1219, May 8, and pp. 1370–1373, May 22, 1905.)—In the first paper the theory dealt with in Abstract No. 377 (1904) is shown not to be applicable to the case of a field oscillating between any two values, instead of symmetrically. In the second, the results according to the author's theory are compared with Maurain's experimental results [see Abstract No. 376 (1904).] L. H. W.

1945. *Protection against the Röntgen Rays.* **J. Bergonié.** (Comptes Rendus, 140. pp. 1566–1567, June 5, 1905.)—A new method has lately been employed in the Medical Electrical department of the University of Bordeaux. It consists simply in placing the operator above the level of the horizontal plane passing through the antikathode, the patient alone being below this level. This object is gained by using a couch only slightly raised above the floor, so that the level of the antikathode is below the level of the operator's knees and the hands and face are well above the dangerous zone. H. W. P. Y.

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1946. *Amorphous Sulphur*; Parts I.–III. *Two Liquid States of Sulphur, $S\lambda$ and $S\mu$, and their Transition-points.* **A. Smith, W. B. Holmes,** and **E. S. Hall.** (Amer. Chem. Soc., Journ. 27. pp. 797–820, July; and pp. 979–1013, Aug., 1905. Contribution from the Chem. Lab. of the Univ. of Chicago. Zeitschr. Phys. Chem. 52. pp. 602–625, Aug. 8, 1905). **A. Smith** (Roy. Soc. Edinburgh, Proc. 25. pp. 588–589, and pp. 590–592, 1904–1905. Abstracts.)—The authors examined the change in viscosity, in solubility, in the coefficient of dilatation, and in the heat absorption observed to accompany the sudden onset of viscosity in liquid sulphur in the neighbourhood of 160°. The results show that there are two liquid states which are partially, but only partially, miscible. These are $S\lambda$, which predominates from the melting-point to 160°, and $S\mu$, which prevails above 160°. As the temperature ascends, saturation of the former with the latter determines the separation of the new phase, and conversely when the temperature falls. Amorphous sulphur is supercooled $S\mu$. In Part III. the influence of foreign bodies on supercooled melted sulphur is examined. D. H. J.

1947. *Dense Liquids Containing Alkaline Mercuriodides.* **Duboin.** (Comptes Rendus, 141. pp. 385–388, Aug. 14, 1905.)—Thoulet's liquid consists of a saturated solution of potassium iodide and mercuric iodide in water. In this paper the properties are described of saturated solutions containing also sodium, lithium, and ammonium in place of potassium:—

	Density.	Refract. Index.
Potassium (filtered at 22·9°)	3·196	1·730 (26°)
Sodium („ 24·75°)	3·46 (26°)	1·797
Lithium („ 24·35°)	3·28 (25·6°)	1·783
Ammonium	2·98 (26°)	1·527

The sodium salt solution is more dense than either Thoulet's liquid or methylene iodide. It is decomposed by water with separation of mercuric iodide, but dissolves unchanged in the alcohols, aldehyde, acetone, the fatty acids, and ethyl acetate. T. M. L.

1948. *Application of the Hypothesis of Dissolved Ice to the Freezing of Water.* **C. S. Hudson.** (Phys. Rev. 21. pp. 16–26, July, 1905.)—The question of dissolved ice has been investigated by the methods of thermodynamics. The results so obtained show that following the hypothesis of Röntgen, that cold water contains ice dissolved in it, it is probable that the ice has a definite solubility in water, and also a definite equilibrium-concentration, both of these concentrations varying with the temperature independently. The assumption of these two concentrations will account for the constant freezing temperature of pure water, and this temperature has been shown to be the temperature at which the equilibrium-concentration is equal to the solubility. Three values for the free energy of the freezing of water have been obtained, corresponding to the three methods by which water is frozen, viz., by distillation, by aid of an osmotic wall, and by freezing a dilute solution. From the equality of these three values, it follows that the concentration of ice in a dilute solution is less than the concentration of ice in pure water at the same temperature. Further, the author shows that this conclusion will account for the fact that dilute solutions have lower freezing-points, and lower temperatures of maximum density than pure water, and derives the formula $dT = (a/1000)RT^2/L$ for the molecular depression of the freezing-point from the foregoing hypothesis that water contains ice dissolved in it. [See also Abstracts Nos. 1221 (1899) and 404 (1901).] F. J. B.

1949. *Phenomena Occurring when the Plait-point Curve meets the Solubility Curve.* **A. Smits.** (Zeitschr. Phys. Chem. 52. pp. 587–601, Aug. 8, 1905. Anorg. Chem. Laborat., Amsterdam, April, 1905.)—Measurements are continued on the ether-anthraquinone system discussed before [see Abstract No. 1126 (1905)]. A Cailletet tube furnished with oil bath and magnetic stirrer is used, and the *p.x.* sections determined for various temperatures in the range ± 300°. It appears that there is a temperature interval between two states of saturated solution, where fluid phases can exist alone or with solid anthraquinone. The retrograde solidification is more easily and more markedly obtained than was expected. An unexpected phenomenon is seen in a separation into three phases *above* the critical point of the solution.

H. H. F. H.

1950. *Solubility of Lead Sulphate in Ammonium Acetate Solutions.* **A. A. Noyes** and **W. H. Whitcomb.** (Amer. Chem. Soc., Journ. 27. pp. 747–759, June, 1905. Phys. Chem. Lab. of the Mass. Inst. of Technology, No. 7.)—The authors' measurements of the conductivity of lead acetate solutions at 25° between N/2 and N/192 show that this salt has an abnormally low degree of ionisation, this being only about 22 per cent. at N/10 concentration, assuming that it dissociates directly into three ions. The solubility in ammonium acetate solution is much greater than in pure water, and is proportional to the concentration of the ammonium acetate. The solubility in sodium acetate is of about the same magnitude as in ammonium acetate. The results all indicate that the increased solubility in acetate solutions is due mainly to the formation of non-ionised lead acetate by metathesis. [See also Böttger, Abstract No. 912 (1904).] T. H. P.

1951. *Salt Solutions in Mixtures of Alcohol and Water.* **A. Fleckenstein.** (Phys. Zeitschr. 6. pp. 419–422, July 1, 1905. Extract from Erlanger Inaugural Dissertation. Physikal-Mediz. Soz., Erlangen, Sitz. Ber., 1904.)—The increase in solubility of ammonium nitrate in alcohol with temperature is very slight and follows the straight-line law, but in water or methyl alcohol the increase is more rapid. Addition of alcohol to water diminishes the solubility of ammonium nitrate, whilst addition of methyl alcohol causes it to increase; the solubility in the mixtures can be approximately calculated according to the law of mixtures only for the higher temperatures. In solutions of ammonium nitrate in aqueous alcohol, layers are formed between definite temperature and concentration limits, the temperature at which this takes place depending only on the content of alcohol and not on that of the salt. T. H. P.

1952. *Osmotic Experiments on Mixtures of Alcohol and Water.* **P. S. Barlow.** (Phil. Mag. 10. pp. 1–12, July, 1905.)—Further experiments have shown that the increase in osmotic pressure after the cell is placed in the alcohol, in Pickering's experiment, is not due to an inflow of alcohol. The increase is only temporary, as has been shown by Findlay and Short [see next Abstract], the permanent result being an outflow from the cell into the alcohol. The temporary rise is due to the fact that for some little time after placing the cell in alcohol the pores outside the membrane remain filled with water, which continues to pass into the cell until the alcohol has had time to diffuse thoroughly into the pores of the pot. The following experiment is of interest as bearing on the origin of osmotic pressure. Pure alcohol and pure water were separated by a guttapercha tissue, the water being within the cell; a large pressure was set up, showing an inflow from the alcohol to the water. With a copper ferrocyanide membrane the direction is reversed. The cause of the current is the same in both cases, namely, the mutual potential energy of solution of the liquids, the direction of the current is conditioned by the membrane. T. M. L.

1953. *Behaviour of Solutions of Propyl Alcohol towards Semi-permeable Membranes.* **A. Findlay** and **F. C. Short.** (Chem. Soc., Journ. 87. pp. 819–822, June, 1905.)—Some years ago, S. U. Pickering stated (Ber. Deut. Chem. Gesell. 24. p. 3639, 1891), that when a porous pot containing a 57 per cent. aqueous solution of propyl alcohol was immersed in either pure water or pure propyl alcohol, the water or the alcohol passed inwards to the solution. Pickering, therefore, ascribed osmotic pressure to the permeability of the membrane for either of the pure components, and its impermeability for the hydrate formed in the solution. The authors have sought, with the use both of porous pots and of copper ferrocyanide membranes, to repeat Pickering's experiments, but they have in no case obtained any indication confirmatory of this observer's results. When simple porous pots were used, the level of the liquid in the manometer tube attached to the porous pot fell in each case, no matter whether the surrounding liquid was water or propyl alcohol. When a copper ferrocyanide membrane was employed, a rise of liquid in the manometer tube was obtained when the pot was surrounded by water, but a fall occurred when the pot was placed in propyl alcohol. The authors discuss the possible explanations of the phenomena obtained by Pickering, and conclude that they were due to differences of velocity of diffusion of water and propyl alcohol. In this case the rise of liquid observed could only have been a temporary one, and the experiment would then lose all its significance for the problem of solution. [This view was confirmed by Pickering, *Chem. Soc., Proc.* 21. p. 171 (1905).] A. F.

1954. *Osmotic Pressure of Colloidal Solutions.* **J. Duclaux.** (Comptes Rendus, 140. pp. 1544–1547, June 5, 1905.)—The author has previously pointed out that the conductivity of a colloidal solution is composed of two parts [see Abstract No. 1826 (1905)], one due to the colloidal particles and the other to the crystalline dissolved substances. The colloidal particles may be regarded as very large ions and, like the latter, exert osmotic pressure. This may be rendered evident and measured by means of a membrane of collodium, which keeps back the colloid but is permeable to the solution; in this way pressures up to that of 1 metre of water may be measured. The number of active colloidal particles, which has already been measured electrically (*loc. cit.*), must be proportional to the magnitude of their osmotic pressure, and this is found to be approximately the case. The osmotic pressure is much less than that of a solution of a crystalloid containing the same number of ions, which in the latter case are much more mobile. With this limitation, the laws of solution may be extended to colloidal solutions. T. H. P.

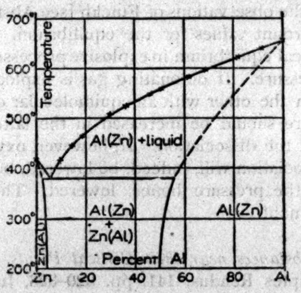
1955. *Association in Mixed Solvents.* **G. Barger.** (Chem. Soc., Journ 87. pp. 1042–1051, July, 1905.)—The author employs his method for determining molecular weights [see Abstract No. 2743 (1904)] for the study of the degree of association of acids, phenols, &c., when dissolved in a mixture of two solvents, one of which is associative and the other non-associative. The chief conclusion drawn from the results obtained is that the molecular weight is normal in most mixtures, association only occurring when the percentage of the dissociative solvent is small. The curves connecting association factors as ordinates with percentage of dissociative solvent present as abscissæ descend at first steeply and then more slowly until they become horizontal or nearly so; this tendency is most marked with acids and oximes, and, among the cases examined, guaiacol in methyl alcohol and chloroform is the only exception. T. H. P.

1956. *Determination of Chemical Equilibrium from Explosive Processes.* II. **W. Nernst.** (Zeitschr. Anorg. Chem. 45. 2. pp. 126–131, May 22, 1905. Inst. f. physikal. Chemie, Göttingen, April, 1905.)—After the completion of an explosion, the velocity of reaction is generally sufficiently great to displace the equilibrium considerably during cooling. Mathematical treatment would seem to be possible when the velocity of reaction is not very great, *e.g.*, in the formation of nitric oxide from detonating gas and air. The principles of chemical kinetics can here be applied. The numbers calculated in this way agree well with the observations of Finckh [see Abstract No. 2004 (1905)], and yield also concordant values for the equilibrium. Another method for arriving at the chemical equilibrium in explosive processes consists in measuring the maximum pressure. If detonating gas is exploded on the one hand with nitrogen and on the other with an equimolecular quantity of hydrogen, the maximum pressure should be increased in the latter case owing to the partial suppression of the dissociation. If, however, oxygen is added instead of hydrogen, the dissociation will, indeed, be lowered, but hydrogen peroxide will be formed and the pressure hence lowered. These conclusions are confirmed by experiment. T. H. P.

1957. *State of Substances near their Critical Points.* **G. Bertrand** and **J. Lecarme.** (Comptes Rendus, 141. pp. 320–323, July 31, 1905.)—When sealed tubes one-third filled with solutions of potassium bichromate in water and alizarin in alcohol, are heated up to their critical temperatures, the meniscus is observed to gradually become flat and then disappear, after some time the whole tube being filled with a uniformly coloured fluid. On recooling, the colour is almost entirely carried down again by the condensed liquid. It seems, therefore, that in the neighbourhood of the critical temperature the substance exists both in the liquid and gaseous states, these being soluble, the one in the other, in all proportions. W. H. Sı.

1958. *Gold-Tin Alloys.* **R. Vogel.** (Zeitschr. Anorg. Chem. 46. 1. pp. 60–75, July 31, 1905. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Describes the observations of cooling curves of this series of alloys and gives an equilibrium diagram; the thermal data are corroborated by a study of the microstructure of the typical alloys. The freezing-point curve shows one well-marked maximum, two marked minima, and three definite kinks; the author concludes that there are three definite compounds ($AuSn$, $AuSn_2$, and $AuSn_4$) and two eutectic alloys in this series. The body $AuSn$ freezes at 418° C., and the cooling-curve shows no lower retardation, the microstructure being also that of a pure substance. The formation is not accompanied by evolution of heat, but by a slight increase of volume [see Abstract No. 99 (1902)]. Alloys containing from 50 to 66 atomic per cent. Sn at first deposit crystals of $AuSn$, but at 308° these crystals react with the mother-liquor to form the compound $AuSn_2$; in alloys containing from 66 to 87 per cent. Sn this compound forms the primary crystallisation, but in alloys containing over 80 per cent. Sn the compound, at temperatures somewhat below the first freezing-point, is transformed into the body $AuSn_4$. The secondary compound at an early stage of the reaction often encloses the primary crystals, preventing the completion of the reaction and giving rise to apparently anomalous structures. The detailed interpretation of the equilibrium diagram, and its correlation with the results of Matthiessen on the electrical resistance, of Laurie on the e.m.f., and of Maey on specific volumes, are given; also illustrations of typical microstructures and the behaviour to etching reagents. W. Ros.

1959. *Aluminium-Zinc Alloys.* **E. S. Shepherd.** (Journ. Phys. Chem. 9. pp. 504–512, June, 1905).—Aluminium-zinc alloys are used as light alloys for foundry work under the names of Alzine and Sibley Casting Metal; they are said to expand on freezing, and thereby to give sharper castings, but this may be due to increased fluidity. An examination of the specific-volume curve for alloys of different percentage compositions showed a break at about 50 per cent., a result that may be explained by assuming the two phases present to be (*a*) pure zinc and (*b*) a solid solution of Zn in Al, containing 50 per cent. of each metal. This conclusion was confirmed by an examination of the cooling-curves and the microscopic structure of the ingots. The complete scheme for the Al-Zn alloys is given in the Fig. T. M. L.



1960. *Magnesium-Tin and Magnesium-Thallium Alloys.* **G. Grube.** (Zeitschr. Anorg. Chem. 46. 1. pp. 76–98, July 31, 1905. Communication from the Inst. für anorg. Chem. d. Univ., Göttingen.)—Methods described in a previous paper on Mg-Pb alloys [see Abstract No. 889 (1905)] were applied to the Mg-Sn series, and, as in the former case, only one compound of the form $SnMg_2$ was found. The equilibrium diagram given shows one well-marked maximum (SnMg) and two minima. The durations of eutectic arrest-points and the evidence of the microscope confirm the existence of this compound, whose freezing-point (780° C.) is considerably higher than that of either constituent. The formation of the compound is accompanied by a marked rise of temperature; the compound itself is hard and brittle, and shows a crystalline fracture. Specimens kept in moist air were completely oxidised in two and a half months. A temperature-concentration diagram is also given for the Mg-Tl series. The freezing-point curve has five branches. The first extends from the freezing-point of Mg to a eutectic point or minimum at 403·7°; it then rises to a well-defined maximum (Tl_3Mg_8). The compound $TlMg_2$ is not indicated by any marked maximum or kink, but its existence is inferred from the fact that the duration of solidification of a lower eutectic reaches its zero value at a point corresponding to this compound. Similar evidence is found for the compound Tl_2Mg_3, but this is also marked by a kink in the curve; beyond this kink the curve drops down past another kink indicating a eutectic point, to the lowest eutectic point of all at slightly above 200°, corresponding to 80 atomic per cent. Tl; from this point the curve rises in a straight line to the freezing-point of pure Tl. The microstructure of typical alloys is described, but owing to their rapid oxidation photomicrographs could not be produced. [See next Abstract.] W. Ros.

1961. *Alloys of Magnesium with Tin and Lead.* **N. S. Kurnakow** and **N. J. Stepanow.** (Zeitschr. Anorg. Chem. 46. 2. pp. 177–192, Aug. 19, 1905. Chem. Laborat. d. Berginstituts, St. Petersburg. Translation from the Russian.)—Melting-point curves and photomicrographs of these two series of alloys are given, with temperature-concentration diagrams. The two series are analogous in showing two eutectics and one definite compound each, solid solutions being entirely absent; these alloys may therefore be taken as typical of a binary system of this type, and in the case of the Mg-Sn alloys the microstructure is easily revealed and exhibits striking examples of typical structures. The chemical compounds found in both series correspond to the formula Mg_2R, where $R = Sn$, or Pb. The authors discuss the nomenclature of such inter-metallic compounds, and consider that they should be called "metallides" on the analogy of hydrides, carbides, silicides, &c., the names "di-magnesium stannide" and plumbide being adopted. The paper is illustrated with 12 photomicrographs, those showing the magnesium-di-magnesium stannide eutectic illustrating its special characteristics. W. Ros.

1962. *Mechanical Properties of Individual Crystals of Iron.* **F. Osmond** and **C. Frémont.** (Comptes Rendus, 141. pp. 361–363, Aug. 7, 1905.)—Large crystals were obtained from a piece of steel which had been decarburised and whose structure had grown during several years of heating. A tensile test of a portion of a crystal, in the direction of a quarternary axis, gave the elastic limit as 13 to 16, breaking load 27·8 kg. per sq. mm., and contraction 85 per cent. Two compression specimens from one crystal, tested after annealing at about 800° C., showed elastic limits at 13·9 and 17·0 kg. per sq. mm., parallel respectively to a quaternary and a ternary axis. The diameters of impressions in Brinell's hardness test were, on faces *p*, *b′*, *a′*, after annealing at 550°, 1·540, 1·500, 1·484; and after annealing at 800°, 1·642, 1·602, and 1·583 respectively. The imprints on crystallographic faces are not exactly circular, as on fine-grained metals; there is a tendency to octagonal contour on faces *p* and *b′*, and hexagonal on *a′*; this fact is in agreement with the compression results, and with the laws of crystals. Under the Frémont impact test an unnotched specimen, whose axis was inclined at about 80° to cleavage planes, bent without breaking, and absorbed 36 kg.-m.; another, having the cleavage planes at right angles to its length, broke without bending, absorbing an insignificant amount of work; the fracture followed a cleavage plane. A third, similar piece, but notched on its tension side, was bent slowly through a large angle without rupture. [See also Abstract No. 1681 (1905).] F. R.

1963. *Concentration Cells in Liquid Ammonia.* **H. P. Cady.** (Journ. Phys. Chem. 9. pp. 477–508, June, 1905.)—Concentration-cells were constructed in which the solvent was liquid ammonia and the solutes were (*a*) $NaNO_3$, (*b*) NaCl, (*c*) $AgNO_3$, (*d*) $Pb(NO_3)_2$, with lead-amalgam electrodes. The e.m.f.'s were determined for several different concentrations of the strong and dilute solutions, and compared with the calculated values. The agreement was less exact than in the case of aqueous solutions, but sufficiently close to show that the same general laws hold good. Experiments were also made with one-fluid cells using electrodes consisting of amalgams of different concentrations. With sodium amalgams as electrodes and a solution of sodium chloride in liquid ammonia as electrolyte, the observed was considerably greater than the calculated e.m.f.; but as this result was exactly reproduced when using pyridine as solvent, the abnormality must be in the amalgams; as these become more dilute the difference between the values becomes less. A third series of experiments was made with oxidation and reduction cells; the oxidising agent in each case was N/50 solution of $KMnO_4$ in liquid ammonia, and the reducing agents were solutions of (*a*) ammonium oxalate, (*b*) potassium iodide, (*c*) sodium thiosulphate, the electrodes in each case being platinum. T. M. L.

1964. *Effect of Membranes in Liquid Chains.* **M. Chanoz.** (Comptes Rendus, 141. pp. 184–185, July 17; and pp. 243–245, July 24, 1905.)—In the liquid chain, aqueous solution MR $\overset{(1)}{|}$ water $\overset{(2)}{|}$ aqueous solution MR, there exists no p.d. if MR is pure and does not hydrolyse. If we insert a membrane, however, at (1) instead of having direct contact, a p.d. appears in the circuit. The e.m.f. developed depends for its sign and intensity (1) on the nature of the membrane, (2) on the nature and concentration of MR, (3) on the relative position of the membrane and the liquids water | MR. With sodium sulphate as MR, an animal membrane which had been immersed in a 0·1 per cent. solution of sulphuric acid and then washed was put in position, and it was found that the side of the membrane which would have been negative without the treatment with dilute sulphuric acid, was positive to the extent of several millivolts. It is sometimes hours before negative electrification appears. From this and similar experiments described, it is clear that the e.m.f. is dependent, amongst other things, on the presence of small quantities of certain substances in the solution of MR or of certain substances that have been in contact with the membrane. The author suggests that there is a formation at the expense of the electrolyte, of a double electrical layer at the contact with the membrane. One of the ions (generally the more mobile) adheres to the membrane and constitutes its positive charge. The other, oppositely-charged ion forms an adjacent layer between the electrolyte and the water, and indicates the variation of potential of the water. The persistent action of traces of acid on certain membranes strongly supports the idea of the more energetic fixing of the + H ion. D. H. J.

1965. *E.M.F. between Metals and Solutions of their Salts.* **G. Carrara** and **L. d'Agostini.** (Gazzetta Chim. Ital. 35. I. pp. 132–144, 1905. Zeitschr. Elektrochem. 11. pp. 386–387, June 16, 1905.)—The authors measure, by Poggendorff's method, the e.m.f. of a number of elements of the type $Hg - HgCl - nKCl - nKNO_3 - AgNO_3 - Ag$, using the metals Cu, Ag, Cd, and Zn, and from the results obtained calculate the absolute potentials between the metals and their salt solutions, and also the solution tensions of the metals. In methyl alcohol, the p.d.'s between the metals and their solutions are, if they are positive, smaller than, and if negative, greater than the corresponding values for aqueous solutions. Assuming that the electrolytic pressure of solutions of metals is independent of the solvent, it follows that the organic solvent gives solutions of electrolytes in which the osmotic pressure of the metallic ions is smaller than that of the corresponding aqueous solutions. The difference must, to a great extent, be attributed to the smaller dissociation of the substance dissolved in the solvent with a smaller ionising power; the contact potentials of the methyl alcohol solutions do tend to approximate to those of aqueous solutions as the dilution is increased. The tensions of the metals in the two solvents are in the same order, but their absolute values are very different in the two cases; the ratio between the values in aqueous and methyl alcoholic solution is 1·3 for Zn, 2·2 for Cd, 0·85 for Cu, and 1 for Ag. For cadmium nitrate in methyl alcohol the p.d.'s are small, whilst measurements of the elevation of boiling-point show that this salt has a degree of dissociation in methyl alcohol of the same order of magnitude as in water. The electrolytic solution pressure must hence vary with the solvent. The authors explain this by supposing that the electrostriction, and therefore the alteration of the solvent by the ions, is different in different solvents. T. H. P.

1966. *Elementary Character of Silicon.* **T. Gross.** (Elektrochem. Zeitschr. 12. pp. 48–50, June, 1905.)—The author argues that chemical elements should not be electrical insulators, and refers to his observation of 1882, that liquid sulphur conducts the current under polarisation when near its boiling-point. The decomposition of the badly-conducting assumed elements might succeed with the aid of alternating currents. He dissolved some freshly precipitated silica in caustic potash and sent through the solution the current from the secondary of an induction apparatus through the primary of which an alternating current of 120 volts and 15 amps. was passing at 100 alternations per sec. The solution was contained in a silver dish, and another, smaller silver dish riveted to a rod of silver served as second electrode. The current had no visible effect, but after about 25 hours the 30 gm. of SiO_2 had diminished to 25·6 gm., and from this residue of SiO_2 the author isolated, in another experiment, 0·3 gm. (14 per cent. of the vanished Si) of a new [?] substance of pinkish colour, hardly soluble in acids, soluble in fused alkali. A similar substance has been obtained from flints. There was no sparking and no gas generation during the electrolysis; experiments with silicon itself are not mentioned.

H. B.

1967. *Magnesium Anodes.* **G. Baborovsky.** (Zeitschr. Elektrochem. 11. pp. 465–482, July 28, 1905. Phys. Chem. Inst., Leipzig.)—Magnesium anodes show the following characteristics: (1) In neutral solutions (chloride, sulphate, &c.) hydrogen is formed and the electrode disintegrates to a black substance, the so-called Beetz's suboxide, which is probably, however, only powdered metal. Under these circumstances the Mg anode goes into solution at a fairly constant valency (about 1·30), which is independent of the current density, temperature, concentration, and composition of the solution. The potential at which it dissolves agrees approximately with that which exists when no current is passing. (2) In alkaline solutions the magnesium surface may exist in an "active," "passive," or "pseudo-active" state. In the active or passive state pure oxygen is liberated at the anode, and the apparent valency of the Mg passing into solution is about 9. In solutions which contain both KOH and KCl, hydrogen and oxygen are liberated simultaneously at the anode. (3) A magnesium anode may cause either oxidation or reduction thus: (*a*) In neutral solutions potassium permanganate and chromate are reduced, but iodides are oxidised with liberation of iodine; (*b*) in alkaline solutions bromides and iodides are oxidised to bromates and iodates, whilst chlorides are unaltered; permanganate appears to be reduced to manganate. T. M. L.

1968. *Very Unequal Electrodes. Valve-cells.* **W. Holtz.** (Phys. Zeitschr. 6. pp. 480–485, Aug. 1, 1905. Écl. Électr. 44. pp. 394–398, Sept. 9, 1905.)—In showing Ampère's rotation of a liquid above a magnetic pole, copper sulphate and copper electrodes (a ring and a wire) were used, and the author found that rotation only took place when the wire was the kathode and the ring the anode. When the wire was made the anode the current stopped. This type of valve appears to have been discovered by Buff in 1848. A systematic series of experiments on this type of cell was made by fitting up a cell with electrode surfaces 600 and 3 sq. mm. in area, and measuring the current that passed when the cell was placed in series with 1, 2, 3, 6, or 12 Leclanché batteries; in some cases reversal caused a large alteration in the strength of the current, in others there was little or no change. The largest alterations were observed in the case of—

Al in dil. H_2SO_4 (N/10, N, and 10N) and in 10 per cent. $AlCl_3$.

Cu in dil. H_2SO_4 (N/10, N, and 10N), in $CuSO_4$ and in $CuCl_2$ (but not in copper nitrate).

CO in N/10H_2SO_4 (but not in normal acid or in cobalt chloride).

Sb and Bi in dil. H_2SO_4 (N/10, N, and 10N).

In the case of Al and Sb the alteration in current strength reached a maximum ratio of about 100 : 1. No marked alteration was caused by reversal of a high voltage in the case of Pt, C, Sn, Zn, Cd, Fe, Pb, Ag, Ni, Au, Mg, and Mn, although tests were made in nearly every case both with dil. H_2SO_4 and with a salt of the metal as electrolyte; at a low voltage, however, Fe, Ni, and Pb in the dilute acid showed differences of the order 10 : 1. T. M. L.

1969. *Influence of the Electrolyte in Aluminium Rectifiers.* **F. Peters** and **A. E. Lange.** (Elektrotechn. Zeitschr. 26. pp. 751–753, Aug. 10, 1905. Écl. Électr. 44. pp. 437–439, Sept. 16, 1905.)—A preliminary account of experiments in which the anode was an Al tube, the bore of which was filled with electrolyte in which a thermometer was immersed, a second thermometer being in the electrolyte outside. The applied p.d. could be raised by steps of 4–5 volts to 150 volts by a potentiometer arrangement. The critical voltage measured is not the same as the critical voltage of Mott; it is here taken as the p.d. applied at which no reduction from the first value of the current on closing the circuit takes place, but instead an increase; this point is found to be well marked. Mott's result, that the valve effect of salts is dependent on the basicity of the acid, is confirmed [see Abstract No. 3259 (1904)]. The nature of the kathion in the electrolyte has a marked effect on the valve action (in barium salt solutions no trace of valve action). Mott has also stated that in the case of mixed electrolytes the insulating power is that of the least effective component of the mixture. This is borne out, but requires modifying by stating the proportions of the separate electrolytes. Thus, taking mixtures of strontium and barium acetate solutions in the proportions 1 to 1/20, 1 to 1/10, 1 to 1/5, and 1 to 1/2, the critical p.d.'s are respectively 65, 40, 24, and 15 volts (about), in all cases higher than with barium acetate alone, which has a critical p.d. of 12 volts. Numerous tables of results are given.

L. H. W.

1970. *Electrolytic Dissociation.* **C. Fredenhagen.** (Ann. d. Physik, 17. 2. pp. 285–331, July 4, 1905.)—Electrolytic dissociation is thermodynamically characterised by a binary equivalent combination of the separation products. This combination postulates a special form of the distribution law. With completely free moving molecules the distribution equilibrium supposes that all components in both gas and liquid phases possess equal chemical potentials. With only free motion in one phase and binary equivalent combination of the products of separation in the other the distribution equilibrium is attained as soon as the unseparated combinations in both phases possess equal potentials and their component equal p.d.'s. The principle of the equality of action and reaction leads to the establishment of an absolute null point, which lies near the actual null point. The notion of the dissociation forces is defined as the work which can be gained on the isothermal and reversible transport of a mass of a given compound from the gaseous into the liquid phase. Between the affinity constants k and k' of a compound in gas and liquid phases and the proportion δ of the concentrations of the undecomposed compound in liquid and gas phases there exists the relation $k/k' = \delta a$, where a is a factor which measures the possible dissociating or associating forces of the solvent, and which on the failure of these forces becomes equal to unity. It is pointed out that, in consideration of the above relation between the affinity constants k and k', the existence of dissociating forces along with the electrolytic dissociation of acids and bases does not appear necessary. It is shown that the powerful molecular forces of attraction between the molecules of the solvent tend towards a binary equivalent combination of the products of decomposition of the solvent, and that they can also cause indirectly such a combination of the decomposition products of the dissolved compounds, since they tend towards an equality of the affinity constants k'_2 and k'_3. The degree of accuracy with which the Faraday law is fulfilled depends, first, on the magnitude of the binary equivalent combining force of the solvent, and second on the difference of the affinity constants. The first condition states that the Faraday law for various solvents is the more invalid the smaller the active molecular forces which exist in them, and from the second condition it follows that for a given condition of a solvent it is fulfilled for different elements with a differing degree of accuracy which depends on the relation between the affinity constants k_2 and k_3. Experiment gives results which agree with this.

J. J. S.

1971. *Physico-Chemical Studies of Explosive Antimony.* III. **E. Cohen** and **T. Strengers.** (Zeitschr. Phys. Chem. 52. pp. 129–170, June 23, 1905. van't Hoff-Laboratorium, Utrecht, March, 1905.)—The authors give the results of an investigation on the influence of temperature, composition of the solutions, current density, &c., on the composition of the resultant explosive antimony. They find that in the electrolysis of solutions of antimony tri-halides in solutions of the corresponding halogen hydracids, more Sb is deposited than corresponds with Faraday's law. The electrochemical equivalent of antimony arrived at increases with the concentration of the Sb salt in the solution. Determinations of the atomic weight of Sb in this way give, therefore, unreliable results. Electrolysis of antimony tribromide or tri-iodide solutions always yields explosive antimony, whatever the concentration of the solution. With antimony chloride, however, this substance is only obtained when the concentration of the salt lies between 10 and 86 per cent.; with concentrations less than 10 per cent. a substance is formed to which the name non-explosive antimony is given. Antimony fluoride solutions always give pure Sb on electrolysis. All the observations, both of the authors and of others, are explained by supposing that the explosive antimony consists of a solid solution of the haloid salt in *α*-antimony, and that the exploded antimony and also non-explosive antimony are solid solutions of the haloid salt in ordinary antimony, *α*-antimony being an allotrope of the ordinary form of the metal. The reason for the deposition of this metastable modification of antimony from certain solutions is unknown. Several striking lecture experiments are described. [See also Abstracts Nos. 1205 (1904) and 656 (1905).] T. H. P.

1972. *Iodine Titration Voltameter.* **D. A. Kreider.** (Amer. Journ. Sci. 20. pp. 1–10, July, 1905. Phys. Zeitschr. 6. pp. 582–588, Sept. 15, 1905.)—A voltameter is described in which a solution of potassium iodide is electrolysed, and the liberated iodine titrated with sodium thiosulphate. The recombination of the electrode products by diffusion renders direct electrolysis of potassium iodide impracticable, and the most satisfactory results are obtained when the anode is submerged in a strong aqueous solution of the iodide under dilute hydrochloric acid, in which the kathode is suspended. The cell in which this is effected consists of a side-necked test-tube drawn out at the bottom to a long capillary, the junction with which is closed by a ground glass rod. The test-tube is closed with a rubber cork, through which pass this glass rod and two glass tubes, allowing the passage of the wires connecting with the electrodes, which are bent into cylindrical form and arranged coaxially with the tube, the anode at the bottom and the kathode above. The apparatus is filled by raising the ground glass rod, and, by diminished pressure, effected through the side-neck, drawing up successively through the capillary the required amount of hydrochloric acid, and then the strong aqueous solution of potassium iodide, thus completely submerging the anode in the iodide, and the hydrochloric acid serving as an electrolyte. As the iodine is liberated, it sinks along the electrode, and by its convection effect renews the iodide at the surface of the electrode without the least disturbance of the supernatant acid. After the current is stopped, the contents of the cell are transferred to a beaker, and titrated with approximately N/10 solution of sodium thiosulphate, previously standardised against pure arsenious oxide. The results obtained with this voltameter agree among themselves to an order of accuracy of about 1 part in 10,000, but are uniformly higher by 0·06–0·09 per cent. than those given by a silver voltameter. W. H. Si.

1973. *Electrolysis with Alternating Currents.* **A. Brochet and J. Petit.** (Annal. Chim. Phys. 5. pp. 307–345, July, 1905. Zeitschr. Elektrochem. 10. pp. 909–922, Dec. 2, 1904, and 11. pp. 441–453, July 14, 1905.)—When used in electrolysis, alternating currents may vary in their action with the chemical nature of the reaction. The anodic or kathodic change may be different from that produced by direct currents under the same conditions, but a Wehnelt or mechanical mercury interrupter placed in a direct-current circuit does not alter the anodic and kathodic reactions. In some few cases the nature of the chemical change produced is altered by varying the current density of the alternating current, but in general this is not the case. The rate of alternation and also the speeds of the reactions taking place exert great influence on the total action. When electrodes are repeatedly used with alternating currents, their surface tends to become spongy, so that the initial and final states of the system differ considerably and the anodic and kathodic actions change owing either to catalytic action or to diminution of the current density caused by the spongy nature of the surface of the metal. Certain of the effects of electrolysis with alternating currents promise to be of practical value. [See also Abstracts Nos. 2788 (1904) and 327, 908, and 911 (1905)].

T. H. P.

1974. *Spontaneous Depression of the Kathode Potential during Electrolysis of Sulphuric Acid.* **J. Tafel** and **B. Emmert.** (Zeitschr. Phys. Chem. 52. pp. 349–373, July 7, 1905. Chem. Inst. der. Univ., Würzburg, March, 1905.)—On the electrolysis of dilute sulphuric acid with a continuous current, using relatively low current-densities, enough platinum is dissolved from the anode to respond to the chemical test. This dissolved platinum is deposited on the kathode and is the cause of the depression of the kathode potential previously described [see Abstract No. 907 (1905)]. Kathodes of different metals vary much in their sensitiveness towards platinum; thus with silver, less than 0·0001 mgm. Pt to 10 sq. cm. kathode surface brings about the depression. In some cases the deposited platinum can become latent in its action for a time, and then active again; consequently a series of measurements with one and the same kathode can give very different results. The action of the platinum does not change the kathode into a "platinum kathode," but brings about some chemical alteration of the surface, probably by some catalytic process. Gold has a similar, but less marked action. Corrected values of the kathode potentials with 0·1 amp. are 1·97–1·98 volts for polished and rough lead, 1·94–1·95 for cadmium, and $>$ 1·7 volts for silver. The authors point out the errors which are likely to arise in polarisation measurements when platinum anodes are used.

T. S. P.

1975. *Alkaline Solutions of Cobaltous Oxide.* **C. Tubandt.** (Zeitschr. Anorg. Chem. 45. 4. pp. 368–373, July 8, 1905. Chem. Inst. der Univ., Halle.)—Using low current-densities and high concentration and temperature of the electrolyte, a cobalt anode dissolves in caustic alkalies with the formation of a blue solution similar to that obtained by the solution of cobaltous oxide in concentrated caustic soda or potash. The solution consists of a colloidal solution of cobaltous hydrate in the alkali. Similar solutions are obtained when alkali containing glycerine is used in the place of pure aqueous alkali.

T. S. P.

1976. *Deposition of Alloys from Mixed Solutions.* **C. B. Jacobs.** (Amer. Chem. Soc., Journ. 27. pp. 972–976, Aug., 1905.)—For plating zinc and nickel simultaneously, without using cyanide solutions or maintaining an abnormal current density, and yet having a comparatively large amount of the electronegative metal (Zn) in the solution, the most suitable liquid is one containing the neutral sulphates of the two metals. The internal resistance of the bath may be regulated by adding varying proportions of ammonium sulphate and chloride. In order to maintain the proper difference in voltage between the two anodes and the kathode so as to regulate the amounts of the two metals deposited on the kathode, two generators running at different voltages were used, one for the zinc and one for the nickel anode, the current returning through the kathode in the bath by a common third leg to the generators. On account of the tendency of the nickel to deposit at lower voltage, and also for the reason that a greater proportion of zinc than nickel was required in the alloy, the generator on the zinc side was run at the high voltage. The metal obtained is regular and firmly adherent, and showed no tendency to peel or crack after the sheets were taken off the kathode and laid out straight. Using zinc and copper anodes, it is only necessary to vary the voltage on either side to change the resultant brass from a reddish one rich in copper to a very pale one containing a high proportion of zinc. T. H. P.

1977. *Electrolysis of Iron Salt Solutions.* **Z. Karaoglanoff.** (Zeitschr. Elektrochem. 11. pp. 489–496, Aug. 4, 1905. Phys.-chem. Inst., Leipzig, June 24, 1905.)—With the exception of the silver voltameter, none of the ordinary forms of weight-, volume- or titration-voltameter is suitable for accurate work. The author gives the results of a study of a titration-voltameter based on the kathodic reduction of ferric to ferrous salt. The oxygen of the air does not oxidise ferrous salts, but the latter must be prevented from reaching the anode. Electrolysis with platinum electrodes shows that evolution of gas begins at the kathode with a so-called critical strength of current, which is proportional to the concentration of the solution. The relation of current to concentration is a function of the temperature, and the relative increase of the velocity of reduction per degree has the constant value 0·080, which is independent of the concentration. With a constant content of iron in the solution, the addition of copper or zinc sulphate, silver nitrate, mercuric chloride, &c., increases, whilst that of chromates, bichromates, or stannic chloride decreases the above critical current. The accelerating catalytic action of salts of the heavy metals is explained by the separation of the metals themselves, and the retarding action by a change produced in the surface of the electrodes. Indeed, the critical current is considerably raised by platinising the electrodes and also by stirring the electrolyte. Finally, it is found that with the iron titration-voltameter it is not difficult to obtain an accuracy of 0·23 coulomb, which corresponds with 0·0003 gm. of silver. T. H. P.

1978. *Rotating Diaphragm.* **W. D. Bancroft.** (Amer. Electrochem. Soc., Trans. 7. pp. 171–176; Discussion, p. 176, 1905.)—A rotating graphite electrode, pivoted on a vertical axis between copper electrodes in a tank of acid copper sulphate, behaves like an ideally reversible electrode, no visible amount of copper being precipitated thereon, though a considerable proportion of the total current flows through the electrode. Experiments with copper wire and foil suspended in a copper sulphate solution between copper electrodes showed that the directing effect of a small difference of potential is small and can be easily masked by surface-tension phenomena and convection currents. W. H. Si.

1979. *Optical Method for Observing Diffusion in Electrolytes.* **C. Hambuechen.** (Amer. Electrochem. Soc., Trans. 7. pp. 305–307, 1905.)—Utilising the fact that when a narrow glass vessel containing a light liquid superposed upon a heavier one, is placed in the path of light from a projection lantern, the image on the screen shows a distinct line between the solutions, even though the eye cannot detect it within the cell, the author has observed the effect of passing a current of 8/10 amp. for a few min. between Fe electrodes suspended in a solution of iron sulphate. Definite horizontal lines appeared, first at the bottom of the cell, but gradually rising to the top, and extending from anode to kathode, indicating that the solution had become stratified by layers of different concentration. A stream of heavy anode solution could also be seen flowing to the bottom of the cell, the lighter kathode solution rising in a steady stream to the top. This explains the corrugated appearance which metallic deposits sometimes assume, and the non-uniformity in density of the electrolyte accounts for the difference in the appearance of the deposit at different parts of the kathode. W. H. Sɪ.

1980. *Electrolytic Reduction of Nitrates.* **E. Müller** and **F. Spitzer.** (Zeitschr. Elektrochem. 11. pp. 509–515, Aug. 11, 1905. From the elektrochem. Laborat. d. techn. Hochschule, Braunschweig.)—The electrolytic reduction of nitrates to nitrites was studied by the authors. Experiments proved that sodium nitrate in alkaline solutions is reduced to nitrite and ammonia upon electrolysis, the quantity of nitrite or ammonia formed depending upon the current density, the temperature, and the kathode material. The p.d.'s shown by the various metals employed as kathodes were taken as indications of the differences in the kathode behaviour of the metals used. The kathode behaviour for nitrate reduction of smooth platinum, of smooth and spongy copper, silver and gold, was investigated. The electrolyte consisted of a dilute solution containing 2·25 gm.-mols. $NaNO_3$ and 0·1 gm.-mol. NaOH per litre, and of a concentrated solution containing 5·64 gm.-mols. $NaNO_3$ and 1·50 gm.-mols. NaOH per litre. The current density employed was 0·006 and 0·1 amp./sq. cm. Potential measurements were made by the Poggendorff compensation method, the decinormal auxiliary electrode Hg, HgCl, N/10KCl, being used. The results showed that spongy silver was the best kathode material for nitrate reduction, being superior to copper, which also gave good results. Gold, either smooth or spongy, was the least suitable for nitrate reduction of the metals investigated. F. J. B.

1981. *Kathodic Disintegration of Tellurium.* **E. Müller** and **R. Lucas.** (Zeitschr. Elektrochem. 11. pp. 521–525, Aug. 18, 1905. From the elektrochem. Laborat. d. techn. Hochschule, Braunschweig.)—In pure water disintegration of a tellurium kathode takes place at voltages varying from 4 to 220, a colloidal solution being formed. The colour of the solution depends on the rate at which the kathode is disintegrated, this being the greater the higher the voltage. Oxygen plays no part in the process. The disintegration is not merely a mechanical process, since the loss in weight of the kathode is proportional to the quantity of electricity used, the tellurium behaving as a monovalent element. The process is represented by (1) $Te + \ominus \longrightarrow Te'$; (2) $2Te' \longrightarrow Te + Te''$. A similar explanation holds for the phenomena observed in alkaline and acid solutions; with $N/10H_2SO_4$ the complication occurs that hydrogen is evolved at the kathode. T. S. P.

1982. *Electrolytic Oxidation of Hydrocarbons of the Benzene Series. II. Ethylbenzene, Cumene, and Cymene.* **H. D. Law** and **F. M. Perkin.**

(Faraday Soc., Trans. 1. pp. 251–261 ; Discussion, p. 261, Aug., 1905. Chem. News, 92. pp. 66–70, Aug. 11, 1905.)—The method of oxidation was to dissolve the hydrocarbon in an excess of acetone and add the mixture to a somewhat smaller volume of 10 to 5 per cent. sulphuric acid. This was electrolysed between a pair of large anodes and a pair of small kathodes, thus securing complete oxidation with very slight reduction. Ethylbenzene, $C_6H_5.CH_2.CH_3$, gave a considerable quantity of the secondary alcohol, $C_6H_5.CHOH.CH_3$, and a small amount of the primary alcohol, $C_6H_5.CH_2.CH_2.OH$; benzaldehyde, $C_6H_5.CHO$, was obtained as a minor product in the later stages of the oxidation. Cymene, $C_3H_7.C_6H_4.CH_3$, gave the aldehyde $C_3H_7.C_6H_4.CHO$, about 10 per cent., and about 20 per cent. of alcohols. Cumene gave somewhat vague products, and the hydrocarbon used does not seem to have been pure. T. M. L.

REFERENCES.

1983. *New Allotrope of Carbon and its Heat of Combustion.* **W. G. Mixter.** (Amer. Journ. Sci. 19. pp. 434–444, June, 1905. Sheffield Lab. of Yale University.) —Calorimetric measurements of the heat of combustion of the carbon in acetylene is about the same as that of graphite but very different from the values for carbon from other sources. Acetylene carbon, which is not identical with graphite, is a good conductor of heat and electricity. (Density at the ordinary temperature 1·919°.) T. H. P.

1984. *Heats of Combustion of Organic Compounds.* **Berthelot.** (Comptes Rendus, 140. pp. 1497–1504, June 5, 1905.)—The author criticises Thomsen's method of determining heats of formation of organic compounds, which depends on combustion in a stream of oxygen at atmospheric pressure. A large number of Thomsen's results have been corrected by later investigations [see Abstract No. 1498 (1905)]. T. H. P.

1985. *Electro-affinity of the Anions.* I. *The Oxalate-ion.* **H. Schäfer** and **R. Abegg.** (Zeitschr. Anorg. Chem. 45. 3. pp. 293–323, June 5, 1905. From anorg. Abt. des chem. Universitätslaborat. zu Breslau. Dissertation.)—The oxalate ion forms complex anions with most of the heavy metals. From a study of a large number of oxalates of the heavy metals, the authors show that the number and stability of the oxalates are very high and that the electro-affinity of the oxalate ion is slight. Ferric oxalate is moderately strongly dissociated into $Fe^{\cdots}$ and $Fe(C_2O_4)_3^{'''}$ ions. T. H. P.

1986. *Solubilities in Mixed Solvents.* II. **W. Herz** and **M. Knoch.** (Zeitschr. Anorg. Chem. 45. 3. pp. 262–269, June 5, 1905. Chem. Inst. d. Univ., Breslau, May 1, 1905.)—Results are given of solubility determinations at 25° of: potassium bromide, ammonium chloride and sulphur in various acetone-water mixtures ; mercuric iodide in mixtures of alcohol and water ; potassium bromide and chloride, sodium and ammonium chlorides, succinic acid, boric acid and iodine in mixtures of glycerine and water. Densities at 25°/4° are given for aqueous solutions of acetone and glycerine. [See also Abstract No. 490 (1905).] T. H. P.

1987. *Reactions which Proceed in Several Stages.* **E. Brunner.** (Zeitschr. Phys. Chem. 52. pp. 89–96, June 9, 1905.)—If in a series of consecutive actions one change proceeds much more slowly than the others, this determines the velocity and the order of the reaction. In electrochemical reactions this determining factor is generally diffusion to and from the electrodes. T. M. L.

1988. *Influence of Sodium Salts on Solubility of Sparingly Soluble Acids.* **J. C. Philip.** (Chem. Soc., Journ. 87. pp. 987–997, July, 1905.)—The results of a study of the relations affecting the increase produced in the solubility of cinnamic, benzoic, salicylic, and *o*-nitrobenzoic acids by the presence of various organic sodium salts. These confirm the theoretical deduction that the extent to which the solubility of a sparingly soluble acid HA is increased by the present of the salt NaA′ is intimately related to the strength of the acid HA′ ; the weaker the latter, the more marked is the increase of solubility of HA produced by NaA′. T. H. P.

1989. *Nature of Osmotic Pressure.* **A. Battelli** and **A. Stefanini.** (Accad. Lincei, Atti, 14. pp. 3–14, July 2, 1905.)—A review of recent work on the subject leads to the conclusions that (1) osmotic phenomena are always produced by differences of surface tension ; (2) the direction of the osmosis is that in which it tends to equalise the surface tensions on each side of the separating membrane ; (3) solutions of equal surface tension, even if not equimolecular, are always in osmotic equilibrium, and (4) it is improbable that osmotic pressure is of a purely kinetic nature. W. H. Si.

1990. *Action of Electrolytic Chlorine on Boiling Toluene.* **J. B. Cohen, H. M. Dawson,** and **P. F. Crosland.** (Chem. Soc., Journ. 87. pp. 1034–1037, July, 1905.)—When ordinary chlorine, evolved from pyrolusite and hydrochloric acid, acts on toluene, it enters the side chain of the toluene molecule. Under the conditions of the authors' experiments, electrolytic chlorine enters the nucleus only, the rate of chlorination being also greater than with ordinary chlorine. The carbon electrodes employed are without action on the chlorination process. T. H. P.

1991. *Sodium-Tin Compounds.* **C. H. Mathewson.** (Zeitschr. Anorg. Chem. 46. 1. pp. 94–112, July 31, 1905. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—The constitution of sodium-tin compounds is investigated by means of cooling-curves and an equilibrium diagram deduced from them. W. Ros.

1992. *Sections of the Saturation Surface Normal to the x Axis when a Three-phase Pressure Exists between Two Temperatures.* **J. D. van der Waals.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 176–185, July 14, 1905. Proc. 8. pp. 184–193, Aug. 17, 1905.)—The real portion of this surface has been sufficiently determined [see Abstract No. 1322 (1905)], but the imaginary portions require further consideration. The investigation is considered in the light of results with mixtures of ethane and alcohol. For details the paper must be consulted, but one result is that at a plait-point, $(dp/dx)T$ is only once equal to zero owing to the occurrence of the factor $(x_2 - x_1)$. H. H. F. H.

1993. *Pressure Variation of t.x. equilibria with Solid and Liquid Phases.* **J. D. van der Waals.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 185–187, July 14, 1905. Proc. 8. pp. 193–195, Aug. 17, 1905.)—Other variants have been considered before [Abstract No. 586 (1904)]. Here the course of the lines with changing p are first considered. Then the case where the two surfaces of equilibrium are separated for values of t and p below those of the plait-points. H. H. F. H.

1994. *Remarkable Equilibria in p.x. sections of a Binary Mixture due to Occurrence of Solid Phases.* **A. Smits.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 187–192, July 14, 1905. Proc. 8. pp. 196–200, Aug. 17, 1905.)—The three-phase line appears to have a temperature as well as a pressure maximum. Ether and anthraquinone give an interesting example. Several figures are given. H. H. F. H.

1995. *Contributions to the Knowledge of the p.x. and p.t. Lines with Substances Dissociating in Gaseous and Liquid States.* **A. Smits.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 192–200, July 14, 1905. Proc. 8. pp. 200–208, Aug. 17, 1905.)—The author distinguishes three cases depending on relation of vapour pressures. From investigation it appears that no triple-point will exist, but rather it resolves into two [see van der Waals, *Ibid. Versl.* p. 482, April, 1897]. Several figures are given. H. H. F. H.

1996. *Autocatalytic Decomposition of Silver Oxide.* **G. N. Lewis.** (Amer. Acad., Proc. 40. No. 23. pp. 719–733, May, 1905. Zeitschr. Phys. Chem. 52. pp. 310–326, July 7, 1905.)—The velocity of decomposition of silver oxide at constant temperature increases to a maximum and subsequently gradually falls to zero. This phenomenon is due to autocatalysis, the catalysing agent being metallic silver. The curve of the reaction velocity approximates very closely to the curve of the equation, $v = \mathrm{K}e^{\mathrm{K}t}/(1+e^{\mathrm{K}t})^2$. A new form of thermostat, which works satisfactorily at high temperatures, is described. T. H. P.

1997. *Equilibrium Measurements with Contact Sulphuric Acid.* **M. Bodenstein** and **W. Pohl.** (Zeitschr. Elektrochem. 11. pp. 373–384, June 16, 1905. Phys. Chem. Inst., Leipzig.)—Mixtures of pure oxygen and sulphur dioxide are passed with constant velocity through a heated quartz tube containing spongy Pt. The mass law holds exactly over the range of temperature employed, 528–897°. Calculation by means of van't Hoff's equation gives for the heat evolution of the reaction $SO_2 + O = SO_3$ the values: 21,500 cal. (897°–789°); 21,700 cal. (789°–680°); and 21,900 cal. (680°–528°). Berthelot obtained the number, 22,600 cal. at the ordinary temperature. T. H. P.

1998. *Contact Process for Sulphuric Acid.* **R. Lucas.** (Zeitschr. Elektrochem. 11. pp. 457–461, July 21, 1905. Techn. Hochschule, Braunschweig.)—Experiments similar to those of Bodländer and Köppen [see Abstract No. 3039 (1904)] show that the values of the equilibrium constants are independent of the initial concentration. These numbers obtained are of the same order of magnitude as, but somewhat smaller than, those given by Knietsch [Abstract No. 510 (1902)] and by Bodländer and Köppen (*loc. cit.*). T. H. P.

1999. *New Hydrogen Ion Catalysis.* **G. Bredig** and **W. Fraenkel.** (Zeitschr. Elektrochem. 11. pp. 525–528, Aug. 18, 1905. Chem. Universitätslaborat., Heidelberg, May, 1905.)—In the presence of hydrogen ions diazoacetic ester is decomposed with the evolution of nitrogen and the addition of water. The reaction is of the first order, and the velocity is directly proportional to the concentration of the hydrogen ions. The reaction can be used to measure extremely small concentrations of hydrogen ions. T. S. P.

2000. *Development of Structure in Colloidal Precipitates.* **H. Bechhold.** (Zeitschr. Phys. Chem. 52. pp. 185–199, June 23, 1905. From the k. Inst. f. experiment. Therapie, Frankfurt A.M.)—An account is given of experiments on the development of structure in amorphous precipitates (Runge's bodies) and especially of the series of *concentric rings of precipitate* which appear when a drop of silver nitrate is allowed to diffuse into bichromated gelatine. The phenomenon is shown to depend mainly on diffusion coupled with the solubility of the precipitate in one of the constituent salts, and the power possessed by salts of coagulating suspensions. T. M. L.

2001. *Microscopic Examination of Caoutchouc.* **P. Breuil.** (Comptes Rendus, 140. pp. 1142–1143, April 25, 1905.)—An account of attempts to apply micrographic methods as used in metallography to the examination of indiarubber, ebonite and guttapercha.

2002. *Dissociation of Carbonates of the Alkaline Earths and of Magnesium Carbonate.* **O. Brill.** (Zeitschr. Anorg. Chem. 45. 3. pp. 275–292, June 5, 1905. Universitäts-inst. f. physikal. Chemie, Göttingen.)—The carbonates were heated in an electric furnace in a stream of dry carbon dioxide, minute quantities (about 2 mgm.) only being used, and the loss of weight being determined by means of the micro-balance. Calcium carbonate was found to decompose abruptly at 825°, and strontium carbonate at 1,155°. With magnesium carbonate the dissociation appears to take place by a series of steps, the final dissociation into magnesia and carbon dioxide taking place at 510°. T. M. L.

2003. *Thermal Decomposition of Formaldehyde and Acetaldehyde.* **W. A. Bone** and **H. L. Smith.** (Chem. Soc., Journ. 87. pp. 910–916, June, 1905.)—When formaldehyde is heated at temperatures above 700°, practically the whole of the vapour decomposes into carbon monoxide and hydrogen. The decomposition is not, to any appreciable extent, reversible. The effect of a hot surface of porous porcelain at 450–500° on the undiluted aldehyde vapour in absence of oxygen is to induce the aldol condensation with formation of crotonaldehyde and steam. A. F.

2004. *Determination of Chemical Equilibrium from Explosive Processes.* I. **K. Finckh.** (Zeitschr. Anorg. Chem. 45. 2. pp. 116–125, May 22, 1905. Inst. f. physikal. Chemie, Göttingen, April, 1905.)—The author's investigations on the formation of hydrogen peroxide during the explosion of a mixture of hydrogen and oxygen, and on the formation of nitric oxide in the explosion of hydrogen, oxygen, and air, show that it cannot be assumed that an equilibrium is arrived at corresponding with the temperature of explosion. T. H. P.

2005. *Constitution of Oxidised Copper.* **Giraud.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 297–298, April 30, 1905.)—Ingots were produced by melting copper and oxide together. With excess of oxide the structure is oxide and copper, with or without eutectic—the latter containing 3·5 per cent. of oxide (Heyn). When copper is in excess, normal results occur, *i.e.*, eutectic, with or without copper. F. R.

2006. *Cobalt Steels.* **L. Guillet.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 348–349, May 31, 1905.)—The author's experiments on steels containing about 0·8 per cent. carbon, and cobalt up to about 30 per cent., indicate that there is no sudden change in mechanical properties with increase of Co. The results obtained by Dumas and by Hadfield point to the same conclusion. All the structures are pearlitic, even with Co up to 50 or 60 per cent. The steels have no industrial value; they do not, as might have been expected, resemble nickel steels. F. R.

2007. *Electrochemical Reactions in Organic Chemistry.* **J. Möller.** (Elektrochem. Zeitschr. 11. pp. 227–231, Feb.; 249–253, March; 12. pp. 6–11, April; 24–27, May; and pp. 51–57, June, 1905.)—A *résumé* of the different electrochemical methods for the production of organic compounds in the laboratory and on an industrial scale. T. H. P.

2008. *Hydrates Formed by Certain Electrolytes in Aqueous Solutions at Different Concentrations.* X. **H. C. Jones** and **H. P. Bassett.** (Amer. Chem. Journ. 33. pp. 534–586, June, 1905.)—The work here described, together with that previously published [Abstract No. 3048 (1904)], indicates that the compounds formed by a dissolved substance with water are very unstable and contain quantities of water varying from 1 molecule up to a very large number. The results obtained afford a partial explanation of the apparent invalidity of the gas laws for concentrated solutions. T. H. P.

2009. *Dissociation of Ternary Electrolytes.* **G. Kümmell.** (Zeitschr. Elektrochem. 11. pp. 341–343, June 2, 1905.)—A reply to Drucker [see Abstract Nos. 684 (1904) and 1140 (1905)]. The author had considered the possibility of complex ions, and shows that none are formed in solutions containing both $MgCl_2$ and KCl. He also discusses the applicability of the law of mass action and the determination of the concentration of the ions by means of potential measurements; freezing-point determinations would be more convenient, but also less reliable, than the isohydric method, for higher concentrations of the ternary electrolytes. H. B.

2010. *Methods and Apparatus used in the Cryogenic Laboratory at Leiden.* **H. Kamerlingh Onnes.** VIII. *Cryostat with Liquid Oxygen for Temperatures below* —210° C. (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 154–157, July 14, 1905. Proc. 8. pp. 79–82, Aug. 17, 1905.)—This cryostat is an improved and modified form of that previously described [Abstract No. 1525 (1903)], and has been used for measurements of hydrogen isotherms. Cryostats with vacuum glasses are not so safe for valuable apparatus as the older forms. IX. *Purification of Gases by Combined Compression and Cooling.* (Ibid. Versl. pp. 157–160. Proc. pp. 82–85.)—In cascade method the ethylene must be freed from time to time from admixed air. An installation was set up for this purpose. Hydrogen prepared as before [*Ibid. Versl.* June, 1900] is now compressed in a tube under liquid air and expanded for use in the measuring apparatus. H. H. F. H.

2011. *The Nickel-Iron Accumulator.* **Elbs.** (Elektrotechn. Zeitschr. 26. p. 756, Aug. 10, 1905. Elect. Rev. 57. p. 255, Aug. 18, 1905. Abstract of paper read before the Deutsch Bunsen-Gesell., June 1–4, 1905.)—The fundamental difference between these cells and the lead cell is referred to, and the probable reactions taking place at the two electrodes are set forth. L. H. W.

2012. *Conduction in Fused and Solid Electrolytes.* **J. W. Richards.** (Amer. Electrochem. Soc., Trans. 7. pp. 71–75; Discussion, pp. 75–77, 1905.)

2013. *Measurement of Electric Currents in Solutions for Lecture Purposes.* **O. Eckstein.** (Amer. Chem. Soc., Journ. 27. pp. 759–761, June, 1905.)—The author describes a device which permits of the direct measurement of the currents passing through the interior of an electrolytic cell and renders it possible to demonstrate the analogy between electrolytic and metallic conduction by a simple lecture experiment. T. H. P.

2014. *Chemistry of Electroplating.* **W. D. Bancroft.** (Journ. Phys. Chem. 9. pp. 277–296, April, 1905. Frank. Inst., Journ. 160. pp. 139–146, Aug., 1905. Mech. Eng. 16. pp. 368–370, Sept. 9, 1905.)—The first paper is an amplification of that dealt with in Abstract No. 60B (1905).

2015. *Electro-analytical Methods.* **N. A. Puschin** and **R. Trechzinsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 4. Section 1, pp. 392–417, 1905.)—The authors record their experience of electro-analytical operations as conducted in the laboratory of the St. Petersburg Electrotechnical Institute. Diagrams are given to show the best arrangement of the appliances used. The authors find that the presence of precipitates in the electrolyte causes no disturbance of the electrolysis, and hence dispense with much unnecessary filtering, decanting, &c. The success which Cowper-Coles obtained in copper refining by the use of movable electrodes led to the general adoption of rotating electrodes. The authors find that stirring the electrolyte by mechanical means gives the same result as rotating the electrodes and leads to a simpler apparatus and more rapid analysis. D. H. J.